TOWN OF TEWKSBURY, MA

Devonshire Road Pump Station Improvements

Bidding Documents for Construction

Woodard & Curran

Project No. 0235334.00
Town of Tewksbury, MA
Contract PW-24-09

woodardcurran.com

January 2025

SECTION 00 01 07

SEALS PAGE

The engineering material and data contained in these Bidding and Contract Documents were prepared under the supervision and direction of the undersigned, whose seal as registered professional engineer is affixed below.

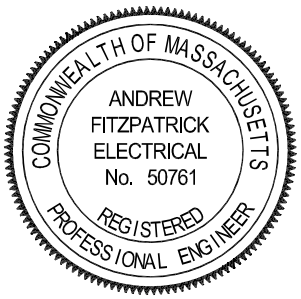
Date of Issue: January 23, 2025

Jason D. Jancaitis

Digitally signed by Jason D. Jancaitis
DN: C=US, E=jjancaitis@woodardcurran.com, O="Woodard & Curran, Inc.", CN=Jason D. Jancaitis
Reason: I agree to the terms defined by the placement of my signature on this document
Contact Info: jjancaitis@woodardcurran.com
Date: 2025.01.23 08:58:52-05'00'

_____

Jason Jancaitis, P.E.
Woodard & Curran, Inc (Engineer)



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Andrew Fitzpatrick, P.E.
Woodard & Curran, Inc (Engineer)

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SECTION 00 11 16

INVITATION TO BID

Town of Tewksbury, MA (Owner) invites Bidders to submit sealed Bids for Devonshire Road Pump Station Improvements, which includes: demolition, replacement, and installation of a backup electrical generator, two submersible chopper pumps, pump mounting equipment, instrumentation, control panels, electrical enclosures, concrete slabs; and all materials and equipment, construction, and services inherent to the Work.

The Work shall be substantially complete within **400 calendar days** from the commencement of Contract Time and completed and ready for final payment within **430 calendar days** from the commencement of Contract Time.

The Project being bid is subject to Massachusetts General Laws, Chapter 30, Section 39M.

Bidding Documents **may be obtained on or after January 23, 2025, at 10:00 a.m.** electronically at no cost by registering at https://www.accentblueprints.com/projects/public (Current Projects - Public Projects) and following the prompts to register/login and obtain a free downloadable set of Bidding Documents. Contact information is included on the website for distribution questions**.**

Bidding Documents **may be examined** at Owner's offices **on or after January 23, 2025, at 10:00 a.m.** at the following location, Monday through Friday between 7:00 a.m. – 3:00 p.m.

Town of Tewksbury, MA
Department of Public Works
999 Whipple Road
Tewksbury, MA 01876

A pre-Bid conference will not be held. A Site visit will be held at 11:00 a.m. local time on January 29, 2025, towards the end of Devonshire Road near Rogers Street. Bidders are encouraged to attend.

Sealed Bids will be received until 11:00 a.m. local time on February 19, 2025, by Owner at the Department of Public Works, 999 Whipple Road, Tewksbury, MA 01876, Attention: Andrew Stack, Town Engineer. Bids will then be publicly opened and read aloud. Bids received after the time of announced opening will not be accepted.

Complete sets of Bidding Documents shall be used in preparing Bids; neither Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents, Bidding Documents or any portion thereof provided by third parties, or for modifications to the Bidding Documents not made by official Addenda, including electronic conversion.

Bid security in the amount of 5 percent of the Bid must accompany the Bid in accordance with the Instructions to Bidders.
Prevailing wage rates as issued by the Director of the Executive Office of Labor and Workforce Development, Department of Labor Standards under the provisions of Massachusetts General Laws, Chapter 149, Sections 26 to 27D inclusive, as amended, apply to this Project. It is the responsibility of the Bidders, before Bid opening, to request if necessary, any additional information on prevailing wage rates for those trades people who may be employed for the proposed Work under the resulting Contract.

Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner further reserves the right to reject the Bid of any Bidder whom it finds, after reasonable inquiry and evaluation, not to be responsible or eligible or not to meet the specified qualification or quality requirements, based on poor references or otherwise. Owner also reserves the right to waive all informalities not involving price, time, or changes in the Work. Award is subject to available funding.

END OF SECTION

SECTION 00 21 13

INSTRUCTIONS TO BIDDERS

ARTICLE 1 – DEFINED TERMS

1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions and Supplementary Conditions, if any. Additional terms used in these Instructions to Bidders have the meanings indicated below and as may be included in the Supplementary Instructions to Bidders.

A. *Issuing Office* – The office from which the Bidding Documents are to be issued and where the bidding procedures are to be administered identified in the Invitation to Bid.

B. *Supplements* – Those portions of the Bidding Requirements to be submitted with and made a condition of a Bid including required submittals.

C. *Notice of Intent to Award* – The written notice to the Successful Bidder indicating conditions precedent to receiving a Notice of Award and Agreement for execution.

ARTICLE 2 – COPIES OF BIDDING DOCUMENTS

2.01 Sets of Bidding Documents may be examined and obtained as stated in the Invitation to Bid.

2.02 Complete sets of Bidding Documents shall be used in preparing Bids; neither Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents, Bidding Documents or any portion thereof provided by third parties, or for modifications to the Bidding Documents not made by official Addenda, including electronic conversion.

2.03 Owner and Engineer, in making copies of Bidding Documents available on the above terms, do so only for the purpose of obtaining Bids for the Work and do not authorize or confer a license for any other use.

ARTICLE 3 – QUALIFICATIONS OF BIDDERS

3.01 To demonstrate Bidders' qualifications to perform the Work, Bidder shall submit written evidence such as financial data, previous experience, present commitments, and such other data requested in the Bidding Documents, and within the time frames stipulated upon Owner's request.

3.02 Bidders shall meet minimum criteria regarding experience and qualifications set forth in the General Requirements and the Specifications.

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ARTICLE 4 – EXAMINATION OF BIDDING DOCUMENTS, OTHER RELATED DATA, AND SITE

4.01 *Subsurface and Physical Conditions*

A. Section 00 73 10 of the Supplementary Conditions identifies:

1. those reports known to Owner of explorations and tests of subsurface conditions at or contiguous to the Site; and

2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).

B. Copies of reports and drawings referenced in Section 00 73 10, if any, are included in the Bidding Documents as indicated in Section 00 31 00. Those reports and drawings are not part of the Contract Documents, but the "technical data" contained therein upon which Bidder is entitled to rely as provided in Paragraph 4.02 of the General Conditions, has been identified and established in Section 00 73 10 of the Supplementary Conditions.

C. Bidder is responsible for any interpretation or conclusion Bidder draws from any "technical data" or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.

4.02 *Underground Facilities*

A. Information and data shown or indicated in the Bidding Documents with respect to existing Underground Facilities at or contiguous to the Site is based upon information and data furnished to Owner and Engineer by owners of such Underground Facilities, including Owner, or others.

4.03 *Hazardous Environmental Condition*

A. Section 00 73 10 of the Supplementary Conditions identifies any reports and drawings known to Owner relating to a Hazardous Environmental Condition identified at the Site.

B. Copies of reports and drawings referenced in Section 00 73 10, if any, are included in the Bidding Documents as indicated in Section 00 31 00. Those reports and drawings are not part of the Contract Documents, but the "technical data" contained therein upon which Bidder is entitled to rely as provided in Paragraph 4.06 of the General Conditions has been identified and established in Section 00 73 10 of the Supplementary Conditions.

C. Bidder is responsible for any interpretation or conclusion Bidder draws from any "technical data" or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.

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4.04 Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to subsurface conditions, other physical conditions, and Underground Facilities, and possible changes in the Bidding Documents due to differing or unanticipated subsurface or physical conditions appear in Paragraphs 4.02, 4.03, and 4.04 of the General Conditions and Section 00 73 10 of the Supplementary Conditions. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to a Hazardous Environmental Condition at the Site, if any, and possible changes in the Contract Documents due to any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work, appear in Paragraph 4.06 of the General Conditions and Section 00 73 10 of the Supplementary Conditions.

4.05 Upon request, Owner may provide Bidder access to the Site to conduct such examinations, investigations, explorations, tests, and studies as Bidder deems necessary for submission of a Bid. Bidder shall be responsible for obtaining permission and necessary permits and insurance for access to the Site. Bidder shall clean up and restore the Site to its former condition upon completion of any such explorations, investigations, tests, and studies. Bidder shall comply with all applicable Laws and Regulations relative to excavation and utility locates.

4.06 Reference is made to Article 7 of the General Conditions and Section 00 73 10 of the Supplementary Conditions for the identification of the general nature of other work that is to be performed at the Site by Owner or others (such as utilities and other prime contractors) that relates to the Work contemplated by these Bidding Documents. On request, Owner will provide to each Bidder for examination access to or copies of contract documents (other than portions thereof related to price) for such other work.

4.07 It is the responsibility of each Bidder before submitting a Bid to:

A. examine and carefully study the Bidding Documents, and the other related data identified in the Bidding Documents;

B. visit the Site and become familiar with and satisfy Bidder as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work;

C. become familiar with and satisfy Bidder as to all federal, state, and local Laws and Regulations that may affect cost, progress, and performance of the Work;

D. carefully study all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) that have been identified in Section 00 73 10 of the Supplementary Conditions, as containing reliable "technical data," and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified in Section 00 73 10 of the Supplementary Conditions, as containing reliable "technical data";

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E. consider the information known to Bidder; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents; and (3) Bidder's safety precautions and programs;

F. agree at the time of submitting its Bid that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price(s) bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents;

G. become aware of the general nature of the work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents;

H. correlate the information known to Bidder, information and observations obtained from visits to the Site, reports and drawings identified in the Bidding Documents, and all additional examinations, investigations, explorations, tests, studies, and data with the Bidding Documents;

I. promptly give Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution thereof by Engineer is acceptable to Bidder; and

J. determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work.

4.08 The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article 4, that without exception the Bid is premised upon performing and furnishing the Work required by the Bidding Documents and applying any specific means, methods, techniques, sequences, and procedures of construction that may be shown or indicated or expressly required by the Bidding Documents, that Bidder has given Engineer written notice of all conflicts, errors, ambiguities, and discrepancies that Bidder has discovered in the Bidding Documents and the written resolutions thereof by Engineer are acceptable to Bidder, and that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performing and furnishing the Work.

ARTICLE 5 – PRE-BID CONFERENCE

5.01 A pre Bid conference will not be held. A Site visit will be held at 11:00 a.m. local time on January 29, 2025, towards the end of Devonshire Road near Rogers Street. Bidders are encouraged to attend.

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5.02 Addenda will be issued to all prospective Bidders of record considered necessary in response to questions arising at the conference as indicated in Article 7. Oral statements may not be relied upon and will not be binding or legally effective.

ARTICLE 6 – SITE AND OTHER AREAS

6.01 The Site is identified in the Bidding Documents. Easements for permanent structures or permanent changes in existing facilities are to be obtained and paid for by Owner unless otherwise provided in the Bidding Documents. All additional lands and access thereto required for temporary construction facilities, construction equipment, or storage of materials and equipment to be incorporated in the Work are to be obtained and paid for by Contractor.

ARTICLE 7 – INTERPRETATIONS AND ADDENDA

7.01 All questions about the meaning or intent of the Bidding Documents are to be submitted to Engineer in writing by email as follows.

Woodard & Curran, Inc.
Jacob Fortin
Email: jfortin@woodardcurran.com
(and a copy to dbrown@woodardcurran.com)

7.02 Interpretations or clarifications considered necessary in response to such questions will be issued by Addenda to all parties recorded as having received the Bidding Documents. **Questions must be received by 3:00 p.m. local time on February 5, 2025, to be answered. Questions received thereafter may not be answered.** Only answers in the Addenda will be binding. Oral statements, interpretations, and clarifications may not be relied upon and will not be binding or legally effective.

7.03 Addenda may be issued to clarify, correct, or change the Bidding Documents as deemed advisable by Owner or Engineer. Addenda will be posted on the website established for the Bidding Documents in the Invitation to Bid. All parties recorded as having received the Bidding Documents will be notified by email on record that Addenda has been posted on the website along with instructions for accessing the Addenda.

ARTICLE 8 – BID SECURITY

8.01 A Bid must be accompanied by Bid security made payable to Owner in an amount of 5 percent of Bidder's maximum Bid price and in the form of a certified check, treasurer's or cashier's check, or money order, or a Bid bond on or consistent with the form included in the Bidding Documents in Section 00 43 13 issued by a surety meeting the requirements of Paragraphs 5.01 and 5.02 of the General and Supplementary Conditions, if any.

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8.02 The Bid security of the apparent Successful Bidder will be retained until Owner awards the Contract to such Bidder, and such Bidder has furnished the required Contract security, insurance documentation and met the other conditions of the Notice of Intent to Award or Notice of Award, and executed the Contract Documents, whereupon the Bid security will be released. If the Successful Bidder fails to furnish the required Contract security, insurance documentation, and meet the other conditions as stated in the Notice of Intent to Award or Notice of Award, and execute and deliver the Contract Documents, Owner may consider Bidder to be in default, annul the Notice of Intent to Award or Notice of Award, and the Bid security of that Bidder will be forfeited. Such forfeiture shall be Owner's exclusive remedy if Bidder defaults.

8.03 The Bid security of other Bidders that Owner believes to have a chance of receiving the award may be retained by Owner until the earlier of 7 days after the Effective Date of the Agreement or 91 days after the Bid opening, whereupon Bid security furnished by such Bidders will be returned. See Supplementary Instructions to Bidders (if any) for additional information.

8.04 Bid security of other Bidders that Owner believes do not have a chance of receiving the award will be returned within 5 days after the Bid opening.

ARTICLE 9 – CONTRACT TIMES

9.01 The number of days within which, or the dates by which, the Work is to be substantially completed and ready for final payment are set forth in the Agreement.

ARTICLE 10 – LIQUIDATED DAMAGES

10.01 Provisions for liquidated damages, if any, are set forth in the Agreement.

ARTICLE 11 – SUBSTITUTE AND "OR-EQUAL" ITEMS

11.01 The Contract, if awarded, will be on the basis of materials and equipment and construction methods or procedures specified or described in the Bidding Documents without consideration of possible substitute or "or-equal" items. Whenever it is specified or described in the Bidding Documents that a substitute or "or-equal" item of material or equipment and construction methods or procedures may be furnished or used by Contractor if acceptable to Engineer, application for such acceptance will not be considered by Engineer until after the Effective Date of the Agreement.

ARTICLE 12 – SUBCONTRACTORS, SUPPLIERS AND OTHERS

12.01 The Bidding Documents may require the identity of certain Subcontractors, Suppliers, individuals, or entities to be submitted to Owner with the Bid.

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12.02 As required in the Bidding Documents, or within 5 days after Bid opening if requested by Owner, Bidder shall submit a listing and experience statement with pertinent information regarding similar projects and other evidence of qualification for each Subcontractor, Supplier, individual, or entity. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor, Supplier, individual, or entity, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit a substitute without an increase in the Bid.

12.03 If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next lowest responsible Bidder that proposes to use acceptable Subcontractors, Suppliers, individuals, or entities. Declining to make requested substitutions will not constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor, Supplier, individual, or entity so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to revocation of such acceptance after the Effective Date of the Agreement as provided in Paragraph 6.06 of the General and Supplementary Conditions, if any.

12.04 Contractor shall not be required to employ any Subcontractor, Supplier, individual, or entity against whom Contractor has reasonable objection.

ARTICLE 13 – PREPARATION OF BID

13.01 The Bid Form and Supplements are included with the Bidding Documents.

13.02 Bids are to be completed as indicated in the Bid Form. All blanks on the Bid Form shall be completed in ink or typewritten and the Bid Form signed in ink. Erasures or alterations shall be initialed in ink by the person signing the Bid Form.

13.03 A Bid by a corporation shall be executed in the corporate name by the president or a vice-president or other corporate officer accompanied by evidence of authority to sign. The corporate seal shall be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation shall be shown.

13.04 A Bid by a partnership shall be executed in the partnership name and signed by a general partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The official address of the partnership shall be shown.

13.05 A Bid by a limited liability company shall be executed in the name of the firm by a member or manager and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm shall be shown.

13.06 A Bid by an individual shall show the Bidder’s name and official address.

13.07 A Bid by a joint venture shall be executed by each joint venturer in the manner indicated on the Bid Form. The official address of the joint venture shall be shown.

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13.08 All names shall be printed in ink below the signatures**.**

13.09 The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers of which shall be filled in on the Bid Form.

13.10 Postal and e-mail addresses and telephone numbers for communications regarding the Bid shall be shown.

13.11 The Bid shall contain evidence of Bidder's authority and qualification to do business in the state where the Project is located, or Bidder shall covenant in writing to obtain such authority and qualification prior to award of the Contract and attach such covenant to the Bid. Bidder's state contractor license number, if any, shall also be shown on the Bid Form. See Supplementary Instructions to Bidders for additional requirements, if any.

13.12 Bidders are advised to carefully review those portions of the Bid Form and Supplements requiring Bidder's representations and certifications that are to be submitted with a Bid or subsequent to the Bid opening, and made a condition of the Bid.

ARTICLE 14 – BASIS OF BID; COMPARISON OF BIDS

14.01 *Bid Pricing*

A. Bidders shall submit a Bid on a lump sum basis as provided for in the Bid Form. Bid price shall be stated in both words and figures.

B. Discrepancies between prices written in words and prices written in figures will be resolved in favor of prices written in words. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

14.02 *Alternates (if any)*

A. Bidders shall include a separate price for each alternate described in the Bidding Documents as provided for in the Bid Form and Supplements, if any. The price for each alternate will be considered in accordance with Article 19.

ARTICLE 15 – SUBMITTAL OF BID

15.01 With each copy of the Bidding Documents, a Bidder is furnished a copy of the Bid Form, the Bid Security Form and Supplements. An original signed hard copy of the Bid Form, the original of the Bid security, and Supplements as listed in the Bid Form, are to be completed and submitted.

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15.02 A Bid shall be submitted no later than the date and time prescribed and at the place indicated in the Invitation to Bid and shall be enclosed in a plainly marked package with the Project title, the name and address of Bidder, and IFB number (if any), and shall be accompanied by the Bid security and other required documents.

15.03 If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid shall be enclosed in a separate package plainly marked on the outside with the notation "**BID ENCLOSED**." **Bids shall be addressed as indicated in the Invitation to Bid.**

15.04 Bidders shall be responsible to confirm the ability of overnight mailing or courier services to deliver to the Owner's offices.

ARTICLE 16 – MODIFICATION AND WITHDRAWAL OF BID

16.01 A Bid may be modified or withdrawn by an appropriate document duly executed in the same manner that a Bid must be executed and delivered in hard copy to the place where Bids are to be submitted prior to the date and time for the opening of Bids. Such modifications and withdrawals may not be transmitted by email.

16.02 If within 24 hours after Bids are opened any Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, that Bidder may withdraw its Bid, and the Bid security will be returned. Thereafter, if the Work is re-Bid, that Bidder may be disqualified from submitting a Bid on the Work.

ARTICLE 17 – OPENING OF BIDS

17.01 Bids will be opened at the time and place indicated in the Invitation to Bid and, unless obviously non-responsive, read aloud publicly.

ARTICLE 18 – BIDS TO REMAIN SUBJECT TO ACCEPTANCE

18.01 All Bids will remain subject to acceptance for the period of time stated in the Bid Form, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to the end of this period.

ARTICLE 19 – EVALUATION OF BIDS AND AWARD OF CONTRACT

19.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner further reserves the right to reject the Bid of any Bidder whom it finds, after reasonable inquiry and evaluation, not to be responsible or eligible or does not to meet the specified qualification or quality requirements, based on poor references or otherwise. Owner also reserves the right to waive all informalities not involving price, time, or changes in the Work.

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19.02 More than one Bid for the same Work from an individual or entity under the same or different names will not be considered. Reasonable grounds for believing that any Bidder has an interest in more than one Bid for the Work may be cause for disqualification of that Bidder and the rejection of all Bids in which that Bidder has an interest.

19.03 In evaluating Bids, Owner will consider whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices and other data as may be requested in the Bid Form or prior to the Notice of Award.

19.04 In evaluating Bidders, Owner will consider the qualifications of Bidders and may consider the qualifications and experience of Subcontractors, Suppliers, and other individuals or entities proposed for those portions of the Work for which the identity of Subcontractors, Suppliers, and other individuals or entities are submitted.

19.05 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders, proposed Subcontractors, Suppliers, individuals, or entities proposed for those portions of the Work in accordance with the Contract Documents.

A. Owner may conduct reference checks for the Bidder. Poor references may be a basis for deeming Bidder as not responsible. Reference questions will include, but are not limited to, product quality and durability, overall work quality, performance, timely delivery/completion, customer service, and general customer satisfaction.

19.06 If the Contract is to be awarded, Owner may award the Contract to the responsible and eligible Bidder, offering the lowest price for the Bid, subject to available funding.

19.07 The Owner will issue a Notice of Intent to Award to the Successful Bidder in the form included in Bidding Documents. Within 15 days of receipt of the Notice of Intent to Award, the Successful Bidder shall comply with the conditions set forth therein and provide requested information. After required reviews and approvals by Owner of bonds and insurance documentation and other conditions, the Owner may issue a Notice of Award in accordance with Article 21.

ARTICLE 20 – CONTRACT SECURITY AND INSURANCE

20.01 Article 5 of the General Conditions, as may be modified by the Supplementary Conditions, sets forth Owner's requirements as to performance and payment bonds and insurance. When the Successful Bidder delivers the executed Agreement to Owner, it shall be accompanied by such bonds.

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A. In case the bonds or insurance documentation submitted by the Successful Bidder do not meet the requirements of the Contract Documents, and changes are to be made before these documents can be accepted by the Owner, the Successful Bidder is obligated to accept an extension of the date of award of the Contract, or the date of issuance of Notice to Proceed, as the case may be, for that period of additional time required to furnish acceptable documents.

ARTICLE 21 – SIGNING OF AGREEMENT

21.01 After required reviews and approvals by Owner of bonds and insurance documentation and other conditions set forth in the Notice of Intent to Award, Owner will issue a Notice of Award to the Successful Bidder. When Owner issues a Notice of Award to the Successful Bidder, it shall be accompanied by unsigned counterparts of the Agreement along with the other Contract Documents which are identified in the Agreement and attached thereto. Within 10 days thereafter, Successful Bidder shall sign and deliver the required number of counterparts of the Agreement and attached documents to Owner. After required reviews and approvals, Owner shall deliver one fully signed set of Contract Documents to Successful Bidder with a complete set of the Drawings.

ARTICLE 22 – RETAINAGE

22.01 Provisions regarding retainage are set forth in the Agreement.

ARTICLE 23 – CONTRACTOR'S WARRANTY AND GUARANTEES; CORRECTION PERIOD

23.01 Provisions regarding Contractor's general warranty and guarantees and correction period are set forth in Paragraphs 6.19, 13.06, 13.07, 13.09 and 14.03 of the General and Supplementary Conditions, if any.

ARTICLE 24 – SAFETY AND HEALTH REGULATIONS

24.01 The Project is subject to the Safety and Health Regulations of the U.S. Department of Labor set forth in Title 29 CFR, Part 1926 and to all subsequent amendments, as a minimum, and other specific requirements identified in the Supplementary Conditions.

ARTICLE 25 – EQUAL EMPLOYMENT OPPORTUNITY, ANTI-DISCRIMINATION, AND AFFIRMATIVE ACTION

25.01 Provisions regarding the requirements for equal employment opportunity, anti-discrimination, and affirmative action programs, if any, are set forth in the Supplementary Conditions.

ARTICLE 26 – WAGE RATE REQUIREMENTS

26.01 Wage rate requirements, if any, are set forth in the Supplementary Conditions.

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ARTICLE 27 – SUPPLEMENTARY INSTRUCTIONS TO BIDDERS

27.01 Supplementary Instructions to Bidders, if any, are included in Section 00 22 13 and may include certain provisions required by Laws and Regulations and funding agencies. Bidders are solely responsible to determine, obtain, review and interpret the full text of applicable Laws and Regulations.

END OF SECTION

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SECTION 00 22 13

SUPPLEMENTARY INSTRUCTIONS TO BIDDERS

The following supplement or modify the Instructions to Bidders. This section includes certain provisions required by Laws and Regulations, but does not represent or reflect all applicable provisions and policies or Laws and Regulations, and may only include excerpts and portions thereof. Other required provisions and policies, and Laws and Regulations, shall be deemed to be so included and incorporated herein. Bidders are solely responsible to determine, obtain, review and interpret the full text of applicable Laws and Regulations. Representations, certifications, compliance statements and forms relating to the subject matter in this Section are included in Section 00 45 05 and must be submitted by each Bidder as part of its Bid. Failure to do so may render a Bid non-responsive.

1.01 APPLICABLE LAWS FOR BID AND AWARD; GENERAL

A. This Contract is being bid under the provisions of Massachusetts General Law (MGL) Chapter 30, Section 39M*, Contracts for construction and materials; manner of awarding.*

B. The Bid and Contract are subject to MGL Chapter 43, Section 27 *Interest In Public Contracts By Public Employees Prohibited; Penalty* and provisions of MGL Chapter 268A, Section 20 *Municipal Employees; Financial Interest In Contracts; Holding One Or More Elected Positions*.

C. Pursuant to Paragraphs 19.01 and 19.06 of the Instructions to Bidder, Bidders must be "eligible" as defined by MGL Chapter 30, Section 39M.

1.02 ADDITIONAL DEFINED TERMS

A. *Bid security* – per the Instructions to Bidders. Also "bid deposit" as used in MGL Chapter 30, Section 39M.

B. *Lowest Responsible and Eligible Bidder* – Also the Successful Bidder. As defined in MGL Chapter 30, Section 39M,

> "The term "lowest responsible and eligible bidder" shall mean the bidder: (1) whose bid is the lowest of those bidders possessing the skill, ability and integrity necessary for the faithful performance of the work; (2) who shall certify, that he is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed in the work; (3) who shall certify that all employees to be employed at the worksite will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins work and who shall furnish documentation of successful completion of said course with the first certified payroll report for each employee; (4) who, where the

provisions of section 8B of chapter 29 apply, shall have been determined to be qualified thereunder; and (5) who obtains within 10 days of the notification of contract award the security by bond required under section 29 of chapter 149; provided that for the purposes of this section the term "security by bond" shall mean the bond of a surety company qualified to do business under the laws of the commonwealth and satisfactory to the awarding authority; provided further, that if there is more than 1 surety company, the surety companies shall be jointly and severally liable."

1.03 APPLICABLE REQUIREMENTS OF THE MGL

A. **Foreign Corporations**: The provisions of MGL Chapter 30, Section 39L, *Public construction work by foreign corporations; restrictions and reports,* requires that if a Bidder is a foreign corporation, it shall provide with its Bid, a certificate from the Commonwealth of Massachusetts Secretary of State stating that the corporation has complied with requirements of Section 15.03 of subdivision A of Part 15 of MGL Chapter 156D and the date of compliance, and further has filed all annual reports required by Section 16.22 of subdivision B of Part 16 of said Chapter 156D, and further, will provide such certificate for each Subcontractor that is a foreign corporation if it receives a Notice of Award. Also see Section 00 45 05 of the Bidding Requirements.

B. **Taxes**: Bidder shall submit with its Bid, a "Certificate of Good Standing" with respect to all returns due and taxes (NOT corporate) from the Commonwealth of Massachusetts Department of Revenue (NOT Secretary of State) certifying Bidder has complied with all laws relating to taxes, reporting of employees and contractors, and withholding and remitting of child support. Bidder will provide such certificate for each Subcontractor if it receives a Notice of Intent to Award. Bidders are encouraged to obtain such Certificate of Good Standing online at

https://www.mass.gov/how-to/request-a-certificate-of-good-standing-tax-compliance-or-a-corporate-tax-lien-waiver

See explanation, instructions, and sample at the end of this Section and see Section 00 45 05 of the Bidding Requirements.

C. **Debarment:** A Bidder is ineligible to bid or enter into a public contract in the Commonwealth of Massachusetts if it has been debarred from bidding on or entering into a public contract under the provisions of MGL Chapter 29, Section 29F, *Debarment from bidding; definitions; lists; notice; affiliates; mitigating circumstances*, or any other applicable debarment provisions of any other chapter of the MGL or any rule or regulations promulgated thereunder.

D. **Financial Statements**: The following shall be submitted prior to execution of the Agreement in accordance with MGL Chapter 30, Section 39R *Definitions; contract provisions; management and financial statements; enforcement.*

- To Owner - A statement by management on internal accounting control and a statement prepared by an independent certified public accountant regarding management's statement (samples at the end of this section); and
- To DCAMM - An audited financial statement for the most recent completed fiscal year.

E. **Labor Preferences and Work Hours**

1. The provisions of MGL Chapter 149, Section 26, *Public works; preference to veterans and citizens; wages,* requires that employment in the construction of public works be subject to preference being given to citizens of the Commonwealth of Massachusetts, citizens of the town or city where the Project is located, veterans and service-disabled veterans, and citizens of the United States. The provisions of MGL Chapter 149, Section 179A*, Preference to citizens in awarding public work contracts, violations,* requires that award of contracts for public work be subject to preference being given to persons who are citizens of the United States.

2. The provisions of MGL Chapter 149, Sections 26, 27, and 27A through 27D, as amended, set forth requirements for prevailing wage rates as issued by the Executive Office of Labor and Workforce Development, Department of Labor Standards. It is the responsibility of the Bidders, before Bid opening, to request if necessary, any additional information on prevailing wage rates for those trades people who may be employed for the proposed Work under the resulting Contract. See Section 00 73 43.

3. The provisions of MGL Chapter 149, Section 30*, Eight hour day and six day week; emergencies; work on highways,* and Section 34*, Public contracts; stipulation as to hours and days of work; void contracts,* apply to this Project.

F. **Sales Tax Exemption:** MGL Chapter 64H, Section 6*, Exemptions*, subsection (f)*,* exempts building materials and supplies to be used in the Project from Commonwealth of Massachusetts sales tax and Bidder shall not include any amount therefor. The words "building materials and supplies" shall include all materials and supplies consumed, employed or expended in the construction, reconstruction, alteration, remodeling or repair of any building, structure, public highway, bridge, or other such public work, as well as such materials and supplies physically incorporated therein. Said words shall also include rental charges for construction vehicles, equipment and machinery rented specifically for use on the Project Site, or while being used exclusively for the transportation of materials for the Project.

G. **Safety and Health:** This Project is subject to Safety and Health Regulations of the U.S. Department of Labor set forth in Title 29 CFR, Part 1926 and to all subsequent amendments, and to Massachusetts Department of Labor and Industries, Division of Occupational Safety 454 CMR 10.00 et seq. "*Construction Industry Rules and Regulations*"; Massachusetts Department of Public Safety 520 CMR 14.00 et seq. "*Excavation and Trench Safety*"; MGL Chapter 82*, The Laying Out, Alteration, Relocation and Discontinuance Of Public Ways and Specific Repairs Thereon;* MGL Chapter 82A, *Excavation and Trench Safety,* and MGL Chapter 149 Section 129A*, Shoring Trenches for local governments*.

1. In addition, MGL Chapter 30, Section 39S, requires that all employees to be employed at the Work Site will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins Work, and documentation of successful completion of said course shall be submitted with the first certified payroll report for each employee. Any employee found on a Work Site subject to this section without documentation of successful completion of a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration shall be subject to immediate removal.

H. **Special Licensing**

1. Work involving the removal, containment, or encapsulation of asbestos or material containing asbestos must be performed by a contractor licensed in accordance with MGL Chapter 149, Section 6B.

2. Sheet metal work must be performed by a contractor licensed in accordance with 271 CMR 1.00, et seq. governing licensing, permitting, and sheet metal work in Massachusetts.

I. **Public Records**: The Bid and Contract are subject to MGL Chapter 66 et seq, *Public Records*, and as such, related submittals, purchase orders, related pricing documents, and invoices will be public documents, and may be available for public and private distribution, except as specifically excluded. The Bidder agrees to provide the Owner copies of any documents requested under this law at no charge to the Owner or the requestor.

J. **Price Adjustments for Certain Materials**: As required by Chapter 150 of the Acts of 2013, the provisions of MGL Chapter 30, Section 38A, *Price adjustment clause in contracts for road, bridge, water and sewer projects awarded under Sec. 39M,* adjustments for fuel (both diesel and gasoline), liquid asphalt and Portland cement shall be made as set forth in Section 00 73 73, SC-12.01.

1.04 OWNER REQUIREMENTS

A. The Owner may consider a Bid irregular and reject it if any of the Bid item prices are excessively unbalanced (either above or below the amount of a reasonable bid) to the potential detriment of the Owner.

B. The Owner reserves the right to reject any Bid received from a Bidder who has received notice of a violation of the Town of Tewksbury's Rules, Regulations, and Bylaws from the Owner within 3 years prior to the Bid date. A violation notice from the Owner will be deemed grounds for disqualification of the Bid.

ATTACHMENTS

A. MA Department of Revenue – Instructions for Requesting a Certificate of Good Standing-Tax Compliance or Corporate Tax Lien Waiver

B. Sample Certificate of Good Standing and/or Tax Compliance

C. Accounting Controls Letters MGLc30s39R

END OF SECTION

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An official website of the Commonwealth of Massachusetts Here's how you know

DOR Certificate of Good Standing and/or Corporate Tax Lien Waiver FAQs

Businesses and individuals: Learn how to request proof you're in good tax standing by requesting a Massachusetts DOR Certificate of Good Standing and/or Corporate Tax Lien Waiver with MassTaxConnect.

Updated: May 13, 2022

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What is a Certificate of Good Standing and do I need one?

A DOR Certificate of Good Standing is the answer when individuals, businesses and other organizations need proof they've filed and paid their Massachusetts taxes in order to:

- Sell a business
  - Some corporations are required to also obtain a Corporate Tax Lien Waiver.
- Obtain financing
- Renew or transfer a liquor license
- Verify a marijuana license
- Gain employment with the Gaming Commission and other agencies

- Participate in the HireNow Program (/news/baker-polito-administration-launches-hirenow-hiring-and-training-employer-grant-program)
- Enter into other business transactions.

DOR does not charge a fee to obtain a Certificate of Good Standing.

How do I apply for a Certificate of Good Standing?

DOR recommends that individuals, businesses and other organizations obtain a Certificate of Good Standing with MassTaxConnect (https://mtc.dor.state.ma.us/mtc/_/). It's fast, easy and secure.

For individuals and businesses registered with MassTaxConnect

- Log in to MassTaxConnect (https://mtc.dor.state.ma.us/mtc/_/).
- Click on **More**
- Under **Other Actions**, select **Request a Certificate of Good Standing**
- Under **Enter - Application Type,**
  - Go to the right-hand side, under **Required,**
  - Select from the following dropdown list:
    - Certificate of Good Standing (standard)
    - Gaming Commission
    - Liquor License
    - Liquor License Transfer
    - Marijuana License Verification
    - Professional License Renewal
    - Waiver of Corporate Tax Lien.
- Complete application and **submit**.

Visit the video tutorial How to File for a Certificate of Good Standing When You are Logged In (https://www.youtube.com/watch?v=apSWETA8r4Q&list=PLfBnwDVE7DgGsk_WprAIk_BVQvxUgUtvk&index=3).

For individuals and businesses NOT registered with MassTaxConnect

- Go to the MassTaxConnect (https://mtc.dor.state.ma.us/mtc/_/) homepage.
- Under **Individuals**, select **Request a Certificate of Good Standing**.
  - **Note**: Non registered businesses must also choose **Individuals**.
- Under **Enter - Application Type,**
  - Go to the right-hand side, under **Required,**

    - Select from the following dropdown list:
        - Certificate of Good Standing (standard)
        - Gaming Commission
        - Liquor License
        - Liquor License Transfer
        - Marijuana License Verification
        - Professional License Renewal.
- Complete application and **submit**.

Please note

- If you must apply by paper, select **Request for a Certificate of Good Standing and/or Tax Compliance or Waiver of Corporate Tax Lien** (/doc/request-for-a-certificate-of-good-standing-andor-tax-compliance-or-waiver-of-corporate-tax-lien/download).
    - Processing of a paper application can take 4 to 6 weeks. DOR **strongly recommends** filing your request online.
- If approved, the Certificate of Good Standing will be mailed within 24-48 hours.
    - Approved certificates can also printed through MassTaxConnect.
- DOR does not charge a fee to obtain Certificate of Good Standing.

What is a Corporate Tax Lien Waiver and do I need one?

A Corporate Tax Lien Waiver (along with a Certificate of Good Standing) is the answer for corporations that are being sold.

DOR does not charge a fee to obtain a Corporate Tax Lien Waiver.

Keep in mind:

- Limit Liability Companies can only obtain a Corporate Tax Lien Waiver if they file and pay corporate returns.
- Non-Profit corporations can not obtain a Corporate Tax Lien Waiver.
- Sole Proprietors can not obtain a Corporate Tax Lien Waiver.

How do I apply for a Corporate Tax Lien Waiver?

DOR recommends that businesses and other organizations obtain a Corporate Tax Lien Waiver with **MassTaxConnect** (https://mtc.dor.state.ma.us/mtc/_/). It's fast, easy and secure.

- Log in to **MassTaxConnect** (https://mtc.dor.state.ma.us/mtc/_/).

- Select the **More** tab
- Under the **Other Actions**, choose **Request a Certificate of Good Standing**
- Under **Enter Application Information**
  - On the right-hand side, under **Required,**
  - Select **Waiver of Corporate Tax Lien** from the dropdown list.
- Complete application and **submit**.

Please note

- If you must apply by paper, select **Request for a Certificate of Good Standing and/or Tax Compliance or Waiver of Corporate Tax Lien** (/doc/request-for-a-certificate-of-good-standing-andor-tax-compliance-or-waiver-of-corporate-tax-lien/download).
  - Processing of a paper application can take 4 to 6 weeks. DOR **strongly recommends** filing your request online.
- DOR does not charge a fee to obtain a Corporate Tax Lien Waiver.

Keep in mind:

- Limit Liability Companies can only obtain a Corporate Tax Lien Waiver if they file and pay corporate returns.
- Non-Profit corporations can not obtain a Corporate Tax Lien Waiver.
- Sole Proprietors can not obtain a Corporate Tax Lien Waiver.

Why can't I submit my application?

You can't submit an application if you have:

- Outstanding liability
- Unfiled returns or
- Other issues with your accounts.

You must file and pay Massachusetts taxes and remedy any other situations before filing for a Certificate of Good Standing or Corporate Tax Lien Waiver.

Can I print the Certificate of Good Standing or Corporate Tax Lien Waiver?

An approved Certificate of Good Standing or Corporate Tax Lien Waiver will be mailed.

However, if you need your certificate or waiver sooner, both users and non-users of MassTaxConnect can print within 24-48 hours after approval.

For individuals and businesses registered with MassTaxConnect

- Log in to **MassTaxConnect** (https://mtc.dor.state.ma.us/mtc/_/)
- Go to the **Action Center** tab and select the **View Letters** link.

You can filter the list of letters by entering **Certificate of Good Standing** or **Corporate Tax Lien Waiver** in the filter bar.

For individuals and businesses NOT registered with MassTaxConnect

When you apply for a Certificate of Good Standing or Corporate Tax Lien Waiver, you will receive an automated email with a confirmation code and number.

It is important to save this email as you will need this information if you choose to print out your certificate or waiver.

To print:

- Go to MassTaxConnect
- On the homepage under **Quick Links**, select **Find a Submission**
- Enter the email address used on your application
- Enter the 6 digit **confirmation code** which you received by email when you applied.
- **Submit**.

Notice of Non-Renewal of Professional License

Professional licenses are issued by the **Division of Occupational Licensure (DOL)** (/division-of-occupational-licensure-dol-disciplinary-actions).

If you owe Massachusetts tax or have not filed state returns, you may not be able to renew your Professional License.

If you received a Notice of Non-Renewal of Professional License, visit **DOR's Professional License Renewal page** (/info-details/massachusetts-professional-license-renewal-faqs).

Contact

Certificate of Good of Standing

Phone

(617) 887-6400 **(tel:+16178876400)**
9 a.m.– 4 p.m., Monday through Friday

Online

Translate a website, webpage or document

(/info-details/how-to-translate-a-website-webpage-or-document-into-the-language-you-want)

RELATED

MassTaxConnect (https://mtc.dor.state.ma.us/mtc/_/)

Video: How to File for a Certificate of Good Standing When You are Logged In (https://www.youtube.com/watch?v=apSWETA8r4Q&list=PLfBnwDVE7DgGsk_WprAIk_BVQvxUgUtvk&index=3)

AP 613: Requesting a Certificate of Good Standing and/or Tax Compliance or Waiver of Corporate Tax Lien (/administrative-procedure/ap-613-requesting-a-certificate-of-good-standing-andor-tax-compliance-or-waiver-of-corporate-tax-lien)

Set up a payment agreement (/info-details/dor-payment-agreement-frequently-asked-questions)

Massachusetts Professional License Renewal FAQs (/info-details/massachusetts-professional-license-renewal-faqs)

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Commonwealth of Massachusetts
Department of Revenue
Christopher C. Harding, Commissioner

mass.gov/dor

Letter ID: L0 #######
Notice Date:
Case ID: 0-000- ##-##

SAMPLE

CERTIFICATE OF GOOD STANDING AND/OR TAX COMPLIANCE

950000

Why did I receive this notice?

The Commissioner of Revenue certifies that, as of the date of this certificate, **COMPANY NAME** is in compliance with its tax obligations under Chapter 62C of the Massachusetts General Laws.

This certificate doesn't certify that the taxpayer is compliant in taxes such as unemployment insurance administered by agencies other than the Department of Revenue, or taxes under any other provisions of law.

This is not a waiver of lien issued under Chapter 62C, section 52 of the Massachusetts General Laws.

What if I have questions?

If you have questions, call us at (617) 887-6367 or toll-free in Massachusetts at (800) 392-6089, Monday through Friday, 8:30 a.m. to 4:30 p.m..

Visit us online!

Visit mass.gov/dor to learn more about Massachusetts tax laws and DOR policies and procedures, including your Taxpayer Bill of Rights, and MassTaxConnect for easy access to your account:

- Review or update your account
- Contact us using e-message
- Sign up for e-billing to save paper
- Make payments or set up autopay

Edward W. Coyle, Jr., Chief
Collections Bureau

SAMPLE

Massachusetts Department of Revenue

PO BOX 7073 BOSTON, MA 02204

CHRISTOPHER C. HARDING, COMMISSIONER
CHARLENE HANNAFORD, DEPUTY COMMISSIONER

Collections Bureau, Certificate Unit
Telephone: (617) 887-6400
Date:

Company
Name

T/P ID XXX XX **XXXX**

The Massachusetts Department of Revenue has received a request for a Certificate of Good Standing for the above listed taxpayer. The Massachusetts Department of Revenue currently considers this taxpayer to be in compliance with the tax laws of the Commonwealth of Massachusetts.

Charlene Hannaford
Deputy Commissioner

SAMPLE LETTER 1
FROM CONTRACTOR REGARDING ACCOUNTING CONTROLS
Pursuant to MGL Chapter 30, Section 39R

TO BE SUBMITTED ON CONTRACTOR'S LETTERHEAD

DATE

INSERT Owner name and address

RE: [INSERT CONTRACT #/PROJECT # AND NAME]

Dear [_____]:

This letter is being submitted pursuant to MGL Chapter 30 §39R(c). Please be advised that our firm has a system of internal accounting controls which assure that:

(1) transactions are executed in accordance with management's general and specific authorization;

(2) transactions are recorded as necessary, to permit preparation of financial statements in conformity with generally accepted accounting principles, and to maintain accountability for assets;

(3) access to assets is permitted only in accordance with management's general or specific authorization; and

(4) the recorded accountability for assets is compared with the existing assets at reasonable intervals and appropriate action was taken with respect to any difference.

Sincerely,

_____
[Name and title of authorized representative of Contractor]

SAMPLE LETTER 2
FROM CPA REGARDING CONTRACTOR ACCOUNTING CONTROLS
Pursuant to MGL Chapter 30, Section 39R

TO BE SUBMITTED ON CPA'S LETTERHEAD

DATE

INSERT Owner name and address

RE: [INSERT CONTRACT #/PROJECT # AND NAME]

Dear [_____]:

Please be advised that we have reviewed the Statement of Internal Accounting Controls prepared by [NAME OF CONTRACTOR], in connection with the above-captioned Project as required under MGL Chapter 30, § 39R. In our opinion, representations of management are consistent with our evaluations of the system of internal accounting controls and such representations are, in addition, reasonable with respect to transactions and assets in amounts which would be material when measured in relation to [NAME OF CONTRACTOR]'s financial statements.

Sincerely,

_____, CPA
[Name]

SECTION 00 31 00

AVAILABLE PROJECT INFORMATION

INFORMATION	LOCATION OF INFORMATION
Easements, Rights-of-Way	Available from Owner
Reference Drawings	Appendix A

END OF SECTION

This page intentionally left blank

SECTION 00 41 01

BID FORM

ARTICLE 1 – DEFINED TERMS

1.01 The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions and Supplementary Conditions, if any.

ARTICLE 2 – BID RECIPIENT

2.01 This Bid is submitted to:

Town of Tewksbury, MA
Department of Public Works
999 Whipple Road
Tewksbury, MA 01876
Attention: Andrew Stack, Town Engineer

2.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 3 – BIDDER'S ACKNOWLEDGEMENTS

3.01 Bidder accepts all of the terms and conditions of the Bidding Documents including, without limitation:

A. those dealing with disposition of Bid security;

B. those included in the Supplementary Instructions to Bidders;

C. insurance and bonding requirements (Payment Bond and Performance Bond each equal to 100% of the total Contract Price) set forth in the General Conditions and Supplementary Conditions, if any;

D. Contract Times as set forth in the Agreement; and

E. provisions for liquidated damages as set forth in the Agreement.

3.02 This Bid will remain subject to acceptance **for 45 days** after the Bid opening or for such longer period of time that Bidder may agree to in writing upon request of Owner.

Based on EJCDC C-410 Suggested Bid Form for Construction Contracts
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3.03 Bidder acknowledges receipt of the following Addenda.

Addendum No.	Addendum Date

3.04 Bidder acknowledges the representations and certifications included in Section 00 45 05 are made a condition of the Bid.

ARTICLE 4 – BASIS OF BID

4.01 Bidder will complete the Work in accordance with the Contract Documents for the following price(s). The method for determining award is as set forth in Section 00 21 13.

BID PRICES SHALL EXCLUDE SALES AND USE TAX.

LUMP SUM BID PRICE

_____

_____

_____ Dollars and _____Cents $_____
(Use words) *(Use figures)*

A. Owner's Contingency Allowance (per Paragraph 11.02 of the General Conditions)

1. For Materials Escalation Price Adjustments (statutory requirement) per MGL c30s38A: NOT TO EXCEED TEN THOUSAND Dollars and ZERO Cents ($10,000.00). Adjustments are established in Section 00 73 73, SC-12.01.

2. For Police Details: NOT TO EXCEED FIVE THOUSAND Dollars and ZERO cents ($5,000)

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TOTAL BID PRICE (LUMP SUM PRICE PLUS CONTINGENCY ALLOWANCES) ABOVE)

_____

_____ $_____

_____ Dollars and _____Cents *(Use figures)*

(Use words)

ARTICLE 5 – TIME OF COMPLETION

5.01 Bidder agrees that the Work will be substantially complete and will be completed and ready for final payment in accordance with Paragraph 14.07 of the General Conditions and Supplementary Conditions, if any, on or before the dates or within the number of calendar days indicated in the Agreement.

5.01 Bidder accepts the provisions of the Agreement as to liquidated damages.

ARTICLE 6 – ATTACHMENTS TO THIS BID

6.01 The following documents are fully completed, submitted with and made a part of and a condition of this Bid.

☐ 00 43 13 Bid Bond

OR

☐ Required Bid security in the form of _____

Supplements

☐ 00 45 05 Bidder's Representations and Certifications **including required documents and submittals specified**

☐ 00 45 13 Bidder's Qualifications

☐ 00 45 19 Non-collusion Affidavit

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ARTICLE 7 – COMMUNICATIONS WITH BIDDER

7.01 Communications concerning this Bid shall be addressed to:

Name _____

Title _____

Business Address _____

_____

Telephone No. _____

Email address _____

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ARTICLE 8 – BID SUBMITTAL

SUBMITTED ON:
EIN/FEIN:

8.01 This Bid is submitted by:

A Corporation

Corporation Name: _____

State of incorporation: _____

Type: _____
(*General Business, Professional, Service, other*)

By: _____
(*Signature – attach evidence of authority to sign*)

Name (*typed or printed*): _____

Title: _____

(CORPORATE SEAL)
Attest: _____
(*Signature of Corporate Secretary*)

Business Address: _____

_____

Phone Nos: _____

Email address: _____

Date of qualification to do business as out-of-state corporation: _____

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A Limited Liability Company (LLC)

LLC Name: _____

State in which organized: _____

By: _____
(*Signature – attach evidence of authority to sign*)

Name (*typed or printed*): _____

Title: _____

Business Address: _____

_____

Phone Nos: _____

Email address: _____

A Joint Venture

First Joint Venturer Name: _____

By: _____
(*Signature – attach evidence of authority to sign*)

Name (*typed or printed*): _____

Title: _____

Business Address: _____

_____

Phone Nos: _____

Email address: _____

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Second Joint Venturer Name: _____

By: _____
(*Signature – attach evidence of authority to sign*)

Name (*typed or printed*): _____

Title: _____

Business Address: _____

_____

Phone Nos: _____

Email address: _____

(Each joint venturer must sign. The manner of signing for each individual, partnership, corporation and limited liability company that is a party to the joint venture should be in the manner indicated above.)

A Partnership

Partnership Name: _____(SEAL)

By: _____
(*Signature of general partner – attach evidence of authority to sign*)

Name (*typed or printed*): _____

Business Address: _____

_____

Phone Nos: _____

Email address: _____

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An Individual

Name (*typed or printed*): _____

By: _____
(*Individual's signature*)

Doing business as: _____

Business Address: _____

_____

Phone Nos: _____

Email address: _____

END OF SECTION

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BID BOND

Any singular reference to Bidder, Surety, Owner or other party shall be considered plural where applicable.

BIDDER *(Name and Address)*:

SURETY *(Name and Address of Principal Place of Business)*:

OWNER *(Name and Address)*:

BID
Bid Due Date:
Description *(Project Name and Include Location)*:

BOND
Bond Number:
Date *(Not earlier than Bid due date)*:
Penal sum _____ $ _____
(Words) (Figures)

Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.

BIDDER	**SURETY**
_____ (Seal)	_____ (Seal)
Bidder's Name and Corporate Seal	Surety's Name and Corporate Seal
By: _____	By: _____
Signature	Signature (Attach Power of Attorney)
_____	_____
Print Name	Print Name
_____	_____
Title	Title
Attest: _____	Attest: _____
Signature	Signature
_____	_____
Title	Title

Note: Above addresses are to be used for giving any required notice. Provide execution by any additional parties, such as joint venturers, if necessary.

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond shall be Owner's sole and exclusive remedy upon default of Bidder.

2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.

3. This obligation shall be null and void if:

3.1 Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or

3.2 All Bids are rejected by Owner, or

3.3 Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).

4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.

5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from Bid due date without Surety's written consent.

6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety and in no case later than one year after Bid due date.

7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.

8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.

9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.

10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.

11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

SECTION 00 45 05

BIDDER'S REPRESENTATIONS AND CERTIFICATIONS

The undersigned, under the penalties of perjury, represents and certifies the following which is made a condition of the Bid.

1.01 BIDDER'S REPRESENTATIONS

A. Bidder has examined and carefully studied the Bidding Documents and other related data identified in the Bidding Documents.

B. Bidder has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

C. Bidder is familiar with and is satisfied as to all Laws and Regulations that may affect cost, progress, and performance of the Work.

D. Bidder has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) that have been identified in Section 00 73 10 of the Supplementary Conditions Paragraph 4.02 as containing reliable "technical data," and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified in Section 00 73 10 of the Supplementary Conditions Paragraph 4.06 as containing reliable "technical data."

E. Bidder has considered the information known to Bidder; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying the specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents; and (3) Bidder's safety precautions and programs.

F. Based on the information and observations referred to in Paragraph E above, Bidder does not consider that further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of the Bid for performance of the Work at the price(s) bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.

G. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.

H. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and the written resolution thereof by Engineer is acceptable to Bidder.

I. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work for which the Bid is submitted.

1.02 BIDDER'S CERTIFICATIONS

A. The Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation.

B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid and has not solicited or induced any individual or entity to refrain from bidding.

C. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph:

1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process;

2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish Bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;

3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and

4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

D. Bidder will comply with the requirements of the Contract Documents, and if Bidder is awarded a Contract, agrees to incorporate applicable provisions into all subcontracts and Purchase Orders so that such provisions will be binding upon each Subcontractor or Supplier, including as a minimum, Statutory Requirements, safety and health regulations; and Wage Rate Requirements.

1.03 BIDDER'S CERTIFICATIONS REQUIRED BY MASSACHUSETTS GENERAL LAW (MGL)

A. The Bid is in all respects bona fide, fair and made without collusion or fraud with any other person. As used in this paragraph the word "person" shall mean any natural person, joint venture, partnership, corporation or other business or legal entity.

B. Bidder certifies no official or employee of the Owner has a financial interest in this Contract or in the expected profit to arise from the Contract, unless the Bidder and Owner, employee or official both have notified public authorities in writing, that the Bidder and the employee fully complied with the provisions of MGL Chapter 43, Section 27 Interest In Public Contracts By Public Employees Prohibited; Penalty and provisions of MGL Chapter 268A, Section 20 Municipal Employees; Financial Interest In Contracts; Holding One Or More Elected Positions.

C. Bidder has submitted a certificate from the Secretary of State of the Commonwealth of Massachusetts that the corporation has complied with requirements of Section 15.03 of subdivision A of Part 15 of MGL Chapter 156D and the date of compliance, and further has filed all annual reports required by Section 16.22 of subdivision B of Part 16 of said Chapter 156D if Bidder is a foreign corporation. Bidder certifies it will provide such certificate for each Subcontractor that is a foreign corporation if it receives a Notice of Intent to Award.

D. Bidder certifies, under the penalties of perjury, to the best of its knowledge and belief, that all state tax returns have been filed and all state taxes paid pursuant to MGL Chapter 62C, Section 49A, and has submitted a Certificate of Good Standing with respect to all returns due and taxes from the Commonwealth of Massachusetts Department of Revenue certifying Bidder has complied with all laws relating to taxes, reporting of employees and contractors, and withholding and remitting of child support. Bidder certifies it will provide such certificate for each Subcontractor if it receives a Notice of Intent to Award.

E. Bidder certifies that if awarded the Contract, the following will be submitted prior to execution of the Agreement in accordance with MGL Chapter 30, Section 39R *Definitions; contract provisions; management and financial statements; enforcement.*

- To Owner - A statement by management on internal accounting control and a statement prepared by an independent certified public accountant regarding management's statement; and
- To DCAMM - An audited financial statement for the most recent completed fiscal year.

F. Bidder certifies that if awarded the Contract, any Work involving the removal, containment, or encapsulation of asbestos or material containing asbestos will only be performed by a licensed contractor in accordance with MGL Chapter 149, Section 6B and any sheet metal Work will be performed by a contractor licensed in accordance with 271 CMR 1.00, et seq. governing licensing, permitting, and sheet metal work in Massachusetts.

G. Bidder is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed in the Work and further certifies that all employees to be employed at the Work Site will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins Work and if Bidder is awarded a Contract, shall furnish documentation of successful completion of said course with the first certified payroll report for each employee.

H. Bidder is not presently debarred from bidding on or entering into a public contract in the Commonwealth of Massachusetts under the provisions of MGL Chapter 29, Section 29F, or any other applicable debarment provisions of any other chapter of the MGL or any rule or regulations promulgated thereunder; and is not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency.

I. Bidder understands the Bid is subject to MGL Chapter 66 et seq, *Public Records*, and as such, related submittals, purchase orders, related pricing documents, and invoices will be public documents, and may be available for public and private distribution, except as specifically excluded. The Bidder agrees to provide the Owner copies of any documents requested under this law at no charge to the Owner or the requestor.

SUBMITTED ON:
By:
Authorized person per Bid Form

END OF SECTION

SECTION 00 45 13

BIDDER'S QUALIFICATIONS

The following data, statements of experience, personnel, equipment and general qualifications are submitted as a part of the Bid and the Bidder represents and guarantees the truthfulness and accuracy thereof and **its ability to meet the qualifications requirements specified in Section 01 43 05 and the Specifications**. Attach additional sheets as necessary properly cross referenced.

1.01 GENERAL

A. Bidder's organization is a _____ (entity type) and has been in business continuously from the year _____.

B. Bidder has operated under the same business name and organization structure for the last 5 years on at least 5 projects ☐ yes ☐ no

If no, indicate other business names: _____

C. Bidder's organization has had experience in construction comparable to that required by the Contract Documents as a prime contractor for _____ years and as a subcontractor for _____ years.

1.02 BIDDER EXPERIENCE

A. Identify at least 5 projects with a total value in excess of $500,000 in the state where the Project is located completed within the past 5 **years which are similar in type, character, physical size, and complexity to that required by the Contract Documents**.

Client/Owner Name/Address	Project Name/Location	CURRENT Contact Name, Phone, Email	Contract Value	Time Period

1.03 ADDITIONAL INFORMATION

A. Submit detailed information for each person or firm evidencing qualifications and experience and ability to meet the requirements specified for the following.

1. Sewage or stormwater bypass pumping: provided, operated, and maintained by a firm that has been regularly engaged in providing bypass pumping for the last 10 years and with at least 10 successful projects.

1.04 CURRENT LICENSES

A. Indicate Bidder and Subcontractor(s) current licenses including design professionals and surveyors.

Name	State	Type	License number

1.05 PERSONNEL

A. Identify supervisory personnel that are currently employed by the Bidder and available for assignment to the Project (project manager, superintendents, principal foremen and engineers).

1. Identify full-time on-Site superintendent in responsible charge of the Work with at least 10 years' experience as superintendent on comparable projects.

2. Identify project manager assigned full-time with at least 10 years' experience as project manager on comparable projects.

Name	Title	Years of Experience
	Full time, on-Site Superintendent	
	Full time Project Manager assigned	

B. Attach detailed resumes of qualifications, previous employers and experience for each supervisory staff listed above.

1.06 PROPOSED DESIGN PROFESSIONALS AND SURVEYORS

A. The following design professionals and surveyors are to be employed or retained by the Bidder and available for assignment to the Project.

Name	Address	Area of Responsibility	Years of Experience

B. Attach detailed resumes of qualifications, previous employers and experience for each design professional and surveyor listed above.

1.07 EMERGENCY RESPONSE CAPABILITIES

A. Describe Bidder's 24 hour/7 days per week emergency response and communication capabilities. Attach additional documentation, as necessary.

1.08 EQUIPMENT

A. Identify equipment available for use on the Project. Indicate whether owned by Bidder's organization or rented. Attach additional sheets, as necessary.

Type of Equipment	Size or Capacity	Owned or Rented

1.09 BUSINESS INTERESTS

A. Identify the names and addresses of the members of the Board of Directors of corporation, or the names and addresses of all persons and parties interested in this Bid as partners of a partnership or as individuals. Attach additional sheets, as necessary.

Name	Address	Telephone No.

B. Identify the bank or banks representing the financial responsibility of the Bidder.

Name of Bank	Address	Contact Name and Telephone No.

1.10 VIOLATIONS

A. Following is a list of violations Bidder and its main Subcontractors have received or been the subject of, or otherwise been involved in, regarding any state or local ethic laws, regulation, code, ordinance, policy, or standard, or offenses arising out of submission of bids or the performance of work on public works projects or contracts over the last 5 years. Attach additional sheets, as necessary.

Name and Location of the Project	
Nature of the Violation/Offense	
Duration and dates during which the violation/offense took place	

Name and Location of the Project	
Nature of the Violation/Offense	
Duration and dates during which the violation/offense took place	

Name and Location of the Project	
Nature of the Violation/Offense	
Duration and dates during which the violation/offense took place	

1.11 LABOR DISPUTES

A. Identify labor disputes the Bidder has been the subject of, or otherwise been involved in, during the last 5 years. For these purposes, "labor disputes" shall include picketing or any other activity which disrupted or delayed the work. Attach additional sheets, as necessary.

Name and Location of the Project	
Nature of the Dispute	
Duration and dates during which the dispute took place	
How the dispute was resolved	

Name and Location of the Project	
Nature of the Dispute	
Duration and dates during which the dispute took place	
How the dispute was resolved	

END OF SECTION

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SECTION 00 45 19

NON-COLLUSION AFFIDAVIT

_____, being duly sworn, depose and, under the penalty of perjury, say that the following is true:

1. I am the person responsible within my firm for the final decision as to the price(s) and amount of this Bid or, if not, that I have written authorization, enclosed herewith, from that person to make the statements set out below on his or her behalf and on the behalf of my firm.

2. The price(s) and amount of this Bid have been arrived at independently, without collusion, consultation, communication, or agreement for the purpose of restricting competition with any other contractor, competitor, Bidder, or potential Bidder.

3. Unless otherwise required by law, neither the price(s) nor the amount of this Bid have been disclosed to any other firm or person who is a Bidder, competitor, or potential Bidder on the Project, and will not be so disclosed either directly or indirectly prior to Bid opening.

4. No attempt has been made or will be made to solicit, cause, or induce any firm, partnership, corporation, or person to submit or not submit a Bid on this Project, or to submit a Bid higher than the Bid of this firm, or submit an intentionally high or noncompetitive Bid or other form of complementary Bid, or for the purpose of restricting competition.

5. The Bid of my firm is made in good faith and not pursuant to any agreement or discussion with, or inducement from, any firm or person to submit a complementary Bid.

6. My firm has not offered or entered into a subcontracting agreement regarding the purchase of materials or services from any firm or person, or offered, promised, or paid cash or anything of value to any firm or person, whether in connection with this or any other Project, in consideration for an agreement or promise by any firm or person to refrain from proposing or to submit a complementary Bid on the Project.

7. My firm has not accepted nor been promised any subcontract or agreement regarding the sale of materials or services to any firm or person, and has not been promised or paid cash or anything of value to any firm or person, whether in connection with this or any other project, in consideration for my firm's submitting a complementary Bid or agreeing to do so, on the Project.

8. I have made a diligent inquiry of all members, officers, employees, and agents of my firm with responsibilities relating to the preparation, approval, or submission of my firm's Bid on the Project and have been advised by each of them that he or she has not participated in any communication, consultation, discussion, agreement, collusion, act, or other conduct inconsistent with any of the statements and representations made in this affidavit.

_____
Company Name

_____
Signature

_____
Company Position

Date: _____

Attest: _____

Date: _____

END OF SECTION

SAMPLE NOTICE OF INTENT TO AWARD (C-00 50 55)

TO BE COMPLETED & ISSUED AFTER BID REVIEW ON OWNER LETTERHEAD

Date

[Bidder Contact
Bidder Company
Bidder Address]

SUBJECT: NOTICE OF INTENT TO AWARD
[PROJECT TITLE/OWNER]

You are notified that your Bid dated _____ for the above Contract has been considered.

You are the apparent Successful Bidder and the Owner intends that the above Contract be awarded to you. The Total Contract Price of the awarded Contract will be $_____ [Lump Sum OR based on Unit Prices], subject to the following conditions being met and subject to required reviews and approvals [OPTIONAL and specifically, funding agency approval by [_____.]

You must comply with the following conditions precedent **within 15 days** of the date of receipt of this Notice of Intent to Award:

1. Deliver the Contract security (Bonds) and insurance documentation as specified in the General Conditions and Supplementary Conditions (Articles 2 and 5).

2. Deliver the following completed and executed certifications and documents:

    a.

    b.

    c. Items to be provided by Subcontractors:

    -

3. Other conditions precedent:

    - *LIST OTHERS IF ANY*

Failure to comply with these conditions within the time specified will entitle Owner to consider you in default, annul this Notice of Intent to Award, and declare your Bid security forfeited.

After confirming that you have complied with the above conditions and required approvals are obtained, Owner will deliver a Notice of Award and the conformed Contract Documents with the Agreement for execution.

INSERT OWNER NAME (Owner)

By:_____
[Name and Title]

Copy to Engineer

SAMPLE NOTICE OF AWARD (C-00 51 00)

TO BE COMPLETED & ISSUED WITH CONFORMED AGREEMENT & CONTRACT ON OWNER LETTERHEAD

Date

[Bidder Contact
Bidder Company
Bidder Address]

SUBJECT: NOTICE OF AWARD
[PROJECT TITLE/OWNER]

You are notified that your Bid dated [insert date] for the above Contract has been considered, and that you are the Successful Bidder and are awarded a Contract for [insert description].

The Total Contract Price of the awarded Contract is $_____ [Lump Sum OR based on Unit Prices].

_____ unexecuted counterparts of the Agreement and 1 copy of the Contract Documents [(except for Drawings)] accompanies this Notice of Award. [OR have been transmitted or made available electronically.] [Sets Drawings will be delivered separately from the other Contract Documents.]

You must comply with the following conditions precedent.

- Return all executed counterparts of the Agreement to Owner **within 10 days** of receipt of this Notice of Award.
- [Add others as necessary]

After obtaining required reviews and approvals for Contract execution, Owner shall deliver one fully executed counterpart of the Agreement, together with any additional copies of the Contract Documents as indicated in Paragraph 2.02 of the General Conditions and Supplementary Conditions, if any.

INSERT OWNER NAME (Owner)

By:_____
[Name and title]

Copy to Engineer

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DSECTION 00 52 10

AGREEMENT FORM

THIS AGREEMENT is by and between Town of Tewksbury, MA ("Owner") and _____ ("Contractor"). Owner and Contractor hereby agree as follows.

ARTICLE 1 – WORK

1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as demolition, replacement, and installation of a backup electrical generator, two submersible chopper pumps, pump mounting equipment, instrumentation, control panels, electrical enclosures, concrete slabs; and all materials and equipment, construction, and services inherent to the Work.

1.02 The Work includes the principal features specified in Section 01 11 00 – Summary of Work.

ARTICLE 2 – THE PROJECT

2.01 The Project under the Contract Documents is generally known as "Devonshire Road Pump Station Improvements".

ARTICLE 3 – ENGINEER

3.01 The Project has been designed by Woodard & Curran, Inc. (Engineer), which is to act as Owner's representative, assume all duties and responsibilities and have the rights and authority assigned to Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

ARTICLE 4 – CONTRACT TIMES

4.01 *Time of the Essence*

A. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.

4.02 *Substantial Completion and Final Payment*

A. The Work shall be substantially complete within **400 calendar days** from the commencement of Contract Times as provided in Paragraph 2.03 of the Standard General and Supplementary Conditions and completed and ready for final payment, in accordance with Paragraph 14.07 of the Standard General Conditions, **430 calendar days** from the commencement of Contract Times.

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4.03 *Liquidated Damages*

A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial loss if the Work is not completed within the times specified in Paragraph 4.02 above, plus any extensions thereof allowed in accordance with Article 12 of the Standard General Conditions and Supplementary Conditions, if any. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty), Contractor shall pay Owner **$1,200** for each day that expires after the time specified in Paragraph 4.02 above for Substantial Completion until the Work is substantially complete. After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Time or any proper extension thereof granted by Owner, Contractor shall pay Owner **$1,200** for each day that expires after the time specified in Paragraph 4.02 above for completion and readiness for final payment until the Work is completed and ready for final payment.

ARTICLE 5 – CONTRACT PRICE

5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents an amount in current funds as follows.

LUMP SUM PRICE	$[DOLLAR AMOUNT]
Owner's Contingency Allowance(s) (per Paragraph 11.02 of the General Conditions)	
• For Materials Escalation Price Adjustment (statutory requirement) per MGL c30s38A: Adjustments are established in Section 00 73 73, SC-12.01.	NOT TO EXCEED $ 10,000.00
• For Police Details	NOT TO EXCEED $ 5,000.00
TOTAL CONTRACT PRICE (LUMP SUM PRICE PLUS CONTINGENCY ALLOWANCE(S) ABOVE)	$[DOLLAR AMOUNT]
[IN WORDS] Dollars and [in Words] Cents	

5.01 *Actual Damages*

A. The pump station must continue to operate during the construction period in order to prevent sanitary sewer overflows or backups at upstream properties in accordance with Section 01 15 20 or provide complete bypass per Section 01 57 31. Contractor shall pay actual damages incurred by Owner for Contractor's failure to maintain operation of the pump stations or provide complete bypass, resulting in damages related thereto.

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ARTICLE 6 – PAYMENT PROCEDURES

6.01 *Submittal and Processing of Payments*

A. Contractor shall submit Applications for Payment in accordance with Article 14 of the Standard General Conditions and Supplementary Conditions, if any. Applications for Payment will be processed by Engineer as provided in the Standard General Conditions and Supplementary Conditions, if any, and the General Requirements.

6.02 *Progress Payments; Retainage*

A. Owner shall make progress payments on account of the Contract Price on the basis of Contractor's Applications for Payment each month during performance of the Work as provided in Paragraph 6.02.A.1 below. All such payments will be measured by the schedule of values established as provided in Paragraph 2.07.A of the Standard General Conditions and Supplementary Conditions, if any, (and in the case of Unit Price Work based on the number of units completed).

1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Engineer may determine or Owner may withhold, including but not limited to liquidated damages, in accordance with Paragraph 14.02 of the Standard General Conditions and Supplementary Conditions, if any, and additional retainage allowed by Laws and Regulations.

    a. Progress Payments of 95 percent for Work completed (with the balance of 5 percent being retainage). If the Work has been 50 percent completed as determined by Engineer, and if the character and progress of the Work have been satisfactory to Owner and Engineer, then as long as the character and progress of the Work remain satisfactory to Owner and Engineer, there may be no additional retainage withheld at Owner's discretion; and

    b. 95 percent of cost of materials and equipment not incorporated in the Work (with the balance of 5 percent being retainage).

2. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to 99 percent of the Work completed (with the balance of 1 percent being retainage), less such amounts as Engineer shall determine in accordance with Paragraph 14.02.B.5 of the General Conditions and Supplementary Conditions, if any, and less the Engineer's estimate of the value of Work to be completed or corrected as shown on the tentative list of items to be completed or corrected (Punch List) attached to the certificate of Substantial Completion and subject to Paragraph 14.04 of the General Conditions and Supplementary Conditions, if any.

    However, retainage for items planted in the ground shall remain at 5 percent of the cost of such items until Final Payment per Massachusetts General Laws Chapter 30, Section 39G.

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6.03 *Final Payment*

A. Upon final completion and acceptance of the Work in accordance with Paragraph 14.07 of the General and Supplementary Conditions, if any, Owner shall pay the remainder of the Contract Price as recommended by Engineer as provided in said Paragraph 14.07.

ARTICLE 7 – INTEREST

7.01 All moneys not paid when due as provided in Article 14 of the General and Supplementary Conditions, if any, shall bear interest at the rate 3 percentage points above the rediscount rate then charged by the Federal Reserve Bank of Boston per Massachusetts General Laws Chapter 30, Section 39G. Interest shall not be accrued on retainage.

ARTICLE 8 – CONTRACTOR'S REPRESENTATIONS AND CERTIFICATIONS

8.01 In order to induce Owner to enter into this Agreement, Contractor makes the following representations:

A. Contractor has examined and carefully studied the Contract Documents and the other related data identified in the Bidding Documents.

B. Contractor has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

C. Contractor is familiar with and is satisfied as to all federal, state, and local Laws and Regulations that may affect cost, progress, and performance of the Work.

D. Contractor has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities), if any, that have been identified in Paragraph SC-4.02 of the Supplementary Conditions as containing reliable "technical data," and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified in Paragraph SC-4.06 of the Supplementary Conditions as containing reliable "technical data."

E. Contractor has considered the information known to Contractor; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Site-related reports and drawings identified in the Contract Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, including any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Contract Documents; and (3) Contractor's safety precautions and programs.

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F. Based on the information and observations referred to in Paragraph 8.01.E above, Contractor does not consider that further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract Documents.

G. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.

H. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.

I. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

8.02 The Contractor certifies, under the penalties of perjury, that:

A. Contractor has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph:

1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process or in the Contract execution;

2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;

3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and

4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

B. Contractor certifies no official or employee of the Owner has a financial interest in this Contract or in the expected profit to arise from the Contract, unless the Contractor and Owner, employee or official both have notified public authorities in writing, that the Contractor and the employee fully complied with the provisions of MGL Chapter 43, Section 27 *Interest In Public Contracts By Public Employees Prohibited; Penalty* and provisions of MGL Chapter 268A, Section 20 *Municipal Employees; Financial Interest In Contracts; Holding One Or More Elected Positions*.

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C. Contractor has complied with all laws of the Commonwealth of Massachusetts relating to taxes, reporting of employees and contractors, and withholding and remitting of child support and, has provided for itself and each Subcontractor, a Certificate of Good Standing from the Department of Revenue with respect to all returns due and taxes and further, certifies that, to the best of its knowledge and belief, all state tax returns have been filed and all state taxes have been paid as required by Law pursuant to Massachusetts General Laws Chapter 62C, Section 49A.

D. If a foreign corporation, Contractor has provided for itself and each Subcontractor that is a foreign corporation, a certificate of the state secretary stating that the corporation has complied with requirements of Massachusetts General Laws Chapter 156D, Part 15, Section 15.03 of subdivision A and the date of compliance, and further has filed all annual reports required by Section 16.22 of subdivision B of Part 16 of said Chapter 156D, pursuant to Massachusetts General Laws Chapter 30, Section 39L.

E. Contractor is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed in the Work and further certifies that all employees to be employed at the Work Site will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins Work and shall furnish documentation of successful completion of said course with the first certified payroll report for each employee, all as required by Massachusetts General Laws Chapter 30, Section 39S.

F. Contractor is not presently debarred from entering into a public contract with the Commonwealth of Massachusetts under the provisions of Massachusetts General Laws Chapter 29, Section 29F, or any other applicable debarment provisions of any other chapter of the General Laws or any rule or regulations promulgated thereunder; and is not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency.

G. Pursuant to Massachusetts General Laws Chapter 30, Section 39R, Contractor has provided a statement by management on internal accounting controls, a statement prepared by an independent certified public accountant regarding management's statement, and an audited financial statement to DCAMM for the most recent completed fiscal year.

H. Contractor shall not participate in or cooperate with an international boycott, as defined in Section 999 (b)(3) and (4) of the Internal Revenue code 1986, as amended, or engage in conduct declared to be unlawful by Section 2 of Chapter 151E of the Massachusetts General Laws.

8.03 The representations and certifications Contractor submitted with its Bid shall remain valid during the period of this Agreement.

8.04 Contractor agrees to incorporate the applicable provisions of the Contract Documents into all subcontracts and Purchase Orders so that such provisions will be binding upon each Subcontractor or Supplier.

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ARTICLE 9 – CONTRACT DOCUMENTS

9.01 *Contents*

A. The Contract Documents consist of the following:

1. This Agreement and attachments

COMPLETE LISTING AFTER AWARD

- Bid Form (submitted by XXXX and dated XXX)
- Bid Supplements and attachments
- Performance Bond
- Payment Bond
- Insurance certificates
- *List others*

2. Forms listed in 00 60 00

3. Standard General Conditions in Section 00 72 05

4. Supplementary Conditions as listed in Section 00 01 10, Table of Contents

5. General Requirements and Specifications as listed in Section 00 01 10, Table of Contents

6. Drawings as listed in Section 00 01 15, List of Drawing Sheets

7. The following which may be delivered or issued on or after the Effective Date of the Agreement and are not attached hereto:

   a. Notice to Proceed

   b. Work Change Directives

   c. Change Orders

B. The documents listed in Paragraph 9.01.A are attached to this Agreement and made a part hereof.

C. There are no Contract Documents other than those listed above in this Article 9.

D. The Contract Documents may only be amended, modified, or supplemented as provided in Paragraph 3.04 of the Standard General Conditions and Supplementary Conditions, if any.

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ARTICLE 10 – MISCELLANEOUS

10.01 *Terms*

A. Terms used in this Agreement will have the meanings stated in the Standard General Conditions and Supplementary Conditions, if any.

10.02 *Assignment of Contract*

A. No assignment by a party hereto of any rights under or interests in the Contract will be binding on another party hereto without the written consent of the party sought to be bound; and, specifically but without limitation, moneys that may become due and moneys that are due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

10.03 *Successors and Assigns*

A. Owner and Contractor each binds itself, its partners, successors, assigns, and legal representatives to the other party hereto, its partners, successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

10.04 *Severability*

A. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon Owner and Contractor, who agree that the Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

10.05 *Contract is Public Record*

A. The Contract is subject to MGL Chapter 66 et seq., *Public Records*, and as such, related submittals, purchase orders, related pricing documents, and invoices will be public documents, and may be available for public and private distribution, except as specifically excluded. The Contractor agrees to provide the Owner copies of any documents requested under this law at no charge to the Owner or the requestor.

SIGNATURES APPEAR ON THE FOLLOWING PAGE

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IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement. Counterparts have been delivered to Owner and Contractor. All portions of the Contract Documents have been signed or have been identified by Owner and Contractor or on their behalf.

This Agreement will be effective on _____ (which is the Effective Date of the Agreement).

OWNER:
TOWN OF TEWKSBURY, MA

By:_____

John Curran
Printed Name

Town Manager
Title

Address for giving notices:

(If Owner is a corporation, attach evidence of authority to sign. If Owner is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of this Agreement.)

CONTRACTOR:
NAME Click or tap here to enter text.

By: _____

_____
Printed Name

_____
Title

License No._____

Attest:_____

_____
Title

Address for giving notices:

Agent for service of process:

(If Contractor is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)

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Approved as to Form by Owner's Counsel:

By:_____
Kevin Feeley, Town Counsel

_____
Date

Pursuant to MGL c.44, s31C, I certify that an appropriation has been made in the total amount of the Agreement.

By: _____
Albano Rego, Town Accountant

_____
Date

END OF SECTION

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EJCDC
ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

PERFORMANCE BOND (Form C-006113.13)

CONTRACTOR *(name and address)*:

SURETY *(name and address of principal place of business)*:

OWNER *(name and address)*:

CONSTRUCTION CONTRACT

Effective Date of the Agreement:
Amount:
Description *(name and location)*:

BOND

Bond Number:
Date *(not earlier than the Effective Date of the Agreement of the Construction Contract)*:
Amount:
Modifications to this Bond Form: ☐ None ☐ See Paragraph 16

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL	**SURETY**
_____ *(seal)*	_____ *(seal)*
Contractor's Name and Corporate Seal	Surety's Name and Corporate Seal
By: _____	**By:** _____
Signature	Signature *(attach power of attorney)*
_____	_____
Print Name	Print Name
_____	_____
Title	Title
Attest: _____	**Attest:** _____
Signature	Signature
_____	_____
Title	Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond shall arise after:

3.1 The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default;

3.2 The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

3.3 The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

4. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

5. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owners concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

5.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:

5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or

5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:

7.1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

7.2 additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and

7.3 liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.

9. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.

10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

11. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default or within

two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit shall be applicable.

12. Notice to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

14. Definitions

14.1 Balance of the Contract Price: The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

14.2 Construction Contract: The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

14.3 Contractor Default: Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

14.4 Owner Default: Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

14.5 Contract Documents: All the documents that comprise the agreement between the Owner and Contractor.

15. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

16. Modifications to this Bond are as follows:

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EJCDC
ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

PAYMENT BOND (Form C-006113.16)

CONTRACTOR *(name and address)*:

SURETY *(name and address of principal place of business)*:

OWNER *(name and address)*:

CONSTRUCTION CONTRACT

Effective Date of the Agreement:
Amount:
Description *(name and location)*:

BOND

Bond Number:
Date *(not earlier than the Effective Date of the Agreement of the Construction Contract)*:
Amount:
Modifications to this Bond Form: ☐ None ☐ See Paragraph 18

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

_____ *(seal)*
Contractor's Name and Corporate Seal

By: _____
Signature

_____
Print Name

_____
Title

Attest: _____
Signature

_____
Title

SURETY

_____ *(seal)*
Surety's Name and Corporate Seal

By: _____
Signature *(attach power of attorney)*

_____
Print Name

_____
Title

Attest: _____
Signature

_____
Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.

2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.

4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.

5. The Surety's obligations to a Claimant under this Bond shall arise after the following:

   5.1 Claimants who do not have a direct contract with the Contractor,

      5.1.1 have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and

      5.1.2 have sent a Claim to the Surety (at the address described in Paragraph 13).

   5.2 Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).

6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.

7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:

   7.1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and

   7.2 Pay or arrange for payment of any undisputed amounts.

   7.3 The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

8. The Surety's total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.

9. Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.

10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.

11. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

12. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or

(2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

13. Notice and Claims to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.

14. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

16. **Definitions**

16.1 **Claim:** A written statement by the Claimant including at a minimum:

1. The name of the Claimant;
2. The name of the person for whom the labor was done, or materials or equipment furnished;
3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;
4. A brief description of the labor, materials, or equipment furnished;
5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;
7. The total amount of previous payments received by the Claimant; and
8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.

16.2 **Claimant:** An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond shall be to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.

16.3 **Construction Contract:** The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.

16.4 **Owner Default**: Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

16.5 **Contract Documents:** All the documents that comprise the agreement between the Owner and Contractor.

17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

18. Modifications to this Bond are as follows:

This page intentionally left blank

SAMPLE NOTICE TO PROCEED (C-00 55 00)

TO BE COMPLETED ON OWNER LETTERHEAD

Date

[Bidder Contact
Bidder Company
Bidder Address]

SUBJECT: NOTICE TO PROCEED
[PROJECT TITLE/OWNER]

You are notified that the Contract Times under the above Contract will commence to run on _____. On or before that date, you are to start performing your obligations under the Contract Documents.

[OR for the following portion(s) of the Work:
[Describe the limits of the Work covered if option above chosen]

A Notice to Proceed for the remaining Work will follow.]

In accordance with Article 4 of the Agreement, the number of days to achieve Substantial Completion is _____, and the number of days to achieve readiness for final payment is _____
OR [*the date of Substantial Completion is _____, and the date of readiness for final payment is _____]

Before you may start any Work at the Site, Paragraph 2.01.B of the General Conditions and Supplementary Conditions if any, provide that you must have delivered to Owner (with copies to Engineer and other identified additional insureds and loss payees) certificates of insurance which you are required to purchase and maintain in accordance with the Contract Documents.

Also, before you may start any Work at the Site, you must:

- Comply with Articles 2.05 and 2.06 of the General and Supplementary Conditions (if any)
- *[*add other requirements*]*

INSERT OWNER NAME (Owner)

By:_____
[Name and title]

Copy to Engineer

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SECTION 00 60 00

PROJECT FORMS

The following forms are included in this Section and shall be used for the Project as specified in the General Conditions and Supplementary Conditions if any, and the General Requirements. Completed and execution versions of these forms used during the Project shall be incorporated into the Agreement and made a part thereof.

Submittal Transmittal (Form C-00 62 11)
Application for Payment (Form C-00 62 76)
Request for Interpretation/Information (Form C-00 63 15)
Field Order (Form C-00 63 36)
Work Change Directive (Form C-00 63 49)
Change Request (Form C-00 63 60)
Change Order (Form C-00 63 63 MA)
Notice of Substantial Completion (Form C-00 65 15)
Certificate of Substantial Completion (Form C-00 65 16)
Notice of Completion (Form C-00 65 18)

END OF SECTION

This page intentionally left blank

SUBMITTAL TRANSMITTAL (Form C-00 62 11)

Owner:		Transmittal No.:	
Project:		Date:	
Contract No.:			
Contract Title:			
Specification Section No.:			

Assign a consecutive, unique number to each submittal and use same on resubmittals. For "Revision", A =original submittal; B = 1st resubmittal; C (and beyond) = additional resubmittals

Submittal (Item) No.	Revision (A B C etc.)	Date	Title/Description	Vendor/Manufacturer	Copies

☐ The material and equipment, and requirements for construction/installation contained in Submittal No.(s) _____ have been reviewed and we certify that they are correct and in strict conformance with the requirements specified (no exceptions or deviations)

☐ The material and equipment and requirements for construction/installation contained in Submittal No.(s) _____ have been reviewed and we certify that they are correct and in strict conformance with the requirements specified except for the following deviations (list below or attach listing):

_____

_____

CONTRACTOR'S NAME_____

ADDRESS_____

BY: _____ DATE: _____

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EJCDC
ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

FORM C-00 62 76

Contractor's Application for Payment No. _____

	Application Period:	Application Date:
To (Owner):	From (Contractor):	Via (Engineer):
Project:	Contract:	
Owner's Contract No.:	Contractor's Project No.:	Engineer's Project No.:

Application For Payment

Change Order Summary

Approved Change Orders		
Number	Additions	Deductions
TOTALS		
NET CHANGE BY CHANGE ORDERS		

1. ORIGINAL CONTRACT PRICE	**$** _____
2. Net change by Change Orders	**$** _____
3. Current Contract Price (Line 1 ± 2)	**$** _____
4. TOTAL COMPLETED AND STORED TO DATE (Column F on Progress Estimate)	**$** _____
5. RETAINAGE:	
a. X _____ Work Completed	**$** _____
b. X _____ Stored Material	**$** _____
c. Total Retainage (Line 5a + Line 5b)	**$** _____
6. AMOUNT ELIGIBLE TO DATE (Line 4 - Line 5c)	**$** _____
7. LESS PREVIOUS PAYMENTS (Line 6 from prior Application)	**$** _____
8. AMOUNT DUE THIS APPLICATION	**$** _____
9. BALANCE TO FINISH, PLUS RETAINAGE (Column G on Progress Estimate + Line 5 above)	**$** _____

Contractor's Certification

The undersigned Contractor certifies that to the best of its knowledge: (1) all previous progress payments received from Owner on account of Work done under the Contract have been applied on account to discharge Contractor's legitimate obligations incurred in connection with Work covered by prior Applications for Payment; (2) title of all Work, materials and equipment incorporated in said Work or otherwise listed in or covered by this Application for Payment will pass to Owner at time of payment free and clear of all Liens, security interests and encumbrances (except such as are covered by a Bond acceptable to Owner indemnifying Owner against any such Liens, security interest or encumbrances); and (3) all Work covered by this Application for Payment is in accordance with the Contract Documents and is not defective.

By:	Date:

Payment of: $ _____
(Line 8 or other - attach explanation of the other amount)

is recommended by: _____ _____
(Engineer) (Date)

Payment of: $ _____
(Line 8 or other - attach explanation of the other amount)

is approved by: _____ _____
(Owner) (Date)

Approved by: _____ _____
Funding Agency (if applicable) (Date)

Approved by: _____ _____

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Progress Estimate - Lump Sum Work

FORM C-00 62 76

Contractor's Application

For (Contract):	Application Number:
Application Period:	Application Date:

			Work Completed		E	F		G
A		B	C	D	Materials Presently Stored (not in C or D)	Total Completed and Stored to Date (C + D + E)	% (F / B)	Balance to Finish (B - F)
Specification Section No.	Description	Scheduled Value ($)	From Previous Application (C+D)	This Period				

Progress Estimate - Unit Price Work

FORM C-00 62 76

Contractor's Application

For (Contract):	Application Number:
Application Period:	Application Date:

A				B	B(2)	C	D	E	F		
Item		Bid Item Quantity	Unit Price	Bid Item Value ($)	Estimated Quantity Installed This Month	Estimated Quantity Installed To Date (Include This Month)	Value of Work Installed to Date	Materials Presently Stored (not in C)	Total Completed and Stored to Date (D + E)	% (F / B)	Balance to Finish (B - F)
Bid Item No.	Description										
	moblize										
	Totals										

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Stored Material Summary FORM C-00 62 76

Contractor's Application

For (Contract):								Application Number:			
Application Period:								Application Date:			
A		B	C		D		E		F		G
Bid Item No.	Supplier Invoice No.	Submittal No. (with Specification Section No.)	Storage Location	Description of Materials or Equipment Stored	Stored Previously		Amount Stored this Month ($)	Subtotal Amount Completed and Stored to Date (D + E)	Incorporated in Work		Materials Remaining in Storage ($) (D + E - F)
					Date Placed into Storage (Month/Year)	Amount ($)			Date (Month/ Year)	Amount ($)	
				Totals							

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REQUEST FOR INTERPRETATION/INFORMATION (Form C-00 63 15)

RFI #: _____ ☐ **Attachment**

To: _____ From: _____

Attn: _____ Issue Date: _____

Project: _____ Required Reply Date: _____

DISTRIBUTION:

Contractor	Owner	Engineer
☐ _____	☐ _____	☐ _____
☐ _____	☐ _____	☐ _____
☐ _____	☐ _____	☐ _____

REFERENCES:

- Specifications: _____ Section: _____ Page/Paragraph: _____
- Drawings: _____ Issue Date: _____ Detail/Sections: _____
- Work Area: _____ Grid/Level: _____

RFI DESCRIPTION:

From: _____ Tel No: _____ Fax: No: _____

Initial: _____ E-mail: _____

RFI REPLY: (response may be transmitted in separate document)

Possible Cost Effect Yes: ☐ No: ☐ **Possible Schedule Effect** Yes: ☐ No: ☐

From: _____ Reply Date: _____ xc: _____

Initial: _____ _____

Based on: CASE Form B-1999

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Field Order (C-00 63 36)

No. _____

Date of Issuance: _____ Effective Date: _____

Project:	Owner:	Owner's Contract No.:
Contract:		Date of Contract:
Contractor:		Engineer's Project No.:

Attention:
You are hereby directed to promptly execute this Field Order issued in accordance with General Conditions Paragraph 9.04.A, for minor changes in the Work without changes in Contract Price or Contract Times. If you consider that a change in Contract Price or Contract Times is required, please notify the Engineer immediately and before proceeding with this Work.

Reference: _____ _____
(Specification Section(s)) (Drawing(s) / Detail(s))

Description: _____

Attachments: _____

	Engineer:

Receipt Acknowledged by Contractor:	Date:

Copy to Owner

This page intentionally left blank

Work Change Directive (Form C-00 63 49)

No. _____

Date of Issuance: _____ Effective Date: _____

Project:	Owner:	Owner's Contract No.:
Contract:		Date of Contract:
Contractor:		Engineer's Project No.:

Contractor is directed to proceed promptly with the following change(s):

Item No.	Description

Attachments (list documents supporting change):

_____

_____

Purpose for Work Change Directive:

Authorization for Work described herein to proceed on the basis of Cost of the Work due to:

☐ Nonagreement on pricing of proposed change.

☐ Necessity to expedite Work described herein prior to agreeing to changes on Contract Price and Contract Time.

Estimated change in Contract Price and Contract Times:

Contract Price $_____ (increase/decrease) Contract Time _____ (increase/decrease) days

Recommended for Approval by Engineer:	Date
Authorized for Owner by:	Date
Received for Contractor by:	Date
Received by Funding Agency (if applicable):	Date:

This page intentionally left blank

CHANGE REQUEST (FORM C-00 63 60)
(Design Changes/Deviations/Substitutions)

CR NO.
DATE

Project:

Request Initiated by:
- ☐ Contractor
- ☐ Owner
- ☐ Engineer

Impact to Contract Price expected ☐
Impact to Contract Time expected ☐
Change Orders will be processed separately

Request submitted as (format):

Description of Change (☐ documentation attached)

Reason for Change

Response: ☐ This constitutes a Written Amendment to the Agreement.

Review of the proposed change/deviation/substitution by Engineer is for general compatibility with the design concept of the Project. This review does not extend to means, methods, sequences, or procedures of construction or to issues of safety incident thereto. This review shall not relieve the Contractor from responsibility for full compliance with the requirements specified in the Contract Documents and to determine and verify the information contained therein.

Recommended By Engineer for Acceptance (subject to above comments if any) ☐ recommended for processing and approval under a separate Change Order NAME: *Signature* *Date*	☐ Approved by Owner (no schedule or cost impact) ☐ Acknowledged by Owner – to be processed and approved under a separate Change Order NAME: *Signature* *Date*
Approved by Contractor ☐ Change Order to be requested NAME: *Signature* *Date*	

This page intentionally left blank

Change Order No. _____

(Form C-00 63 63) MA

Date of Issuance: _____ Effective Date: _____

Project:	Owner:	Owner's Contract No.:
Contract:		Date of Contract:
Contractor:		Engineer's Project No.:

The Contract Documents are modified as follows upon execution of this Change Order:

Description:

Attachments (list documents supporting change):

CHANGE IN CONTRACT PRICE:	**CHANGE IN CONTRACT TIMES:**
Original Contract Price: $_____	Original Contract Times: ☐ Working days ☐ Calendar days Substantial completion (days or date): _____ Ready for final payment (days or date): _____
[Increase] [Decrease] from previously approved Change Orders No. _____ to No. _____: $_____	[Increase] [Decrease] from previously approved Change Orders No. _____ to No. _____: Substantial completion (days): _____ Ready for final payment (days): _____
Contract Price prior to this Change Order: $_____	Contract Times prior to this Change Order: Substantial completion (days or date): _____ Ready for final payment (days or date): _____
[Increase] [Decrease] of this Change Order: $_____	[Increase] [Decrease] of this Change Order: Substantial completion (days or date): _____ Ready for final payment (days or date): _____
Contract Price incorporating this Change Order: $_____	Contract Times with all approved Change Orders: Substantial completion (days or date): _____ Ready for final payment (days or date): _____

RECOMMENDED:	ACCEPTED:	ACCEPTED:
By: _____	By: _____	By: _____
Engineer (Authorized Signature)	Owner (Authorized Signature)	Contractor (Authorized Signature)
Date: _____	Date: _____	Date: _____
Approved by Funding Agency (if applicable):	Approved by Funding Agency (if applicable):	Approved by Funding Agency (if applicable):
_____	_____	_____
Date: _____	Date: _____	Date: _____

Pursuant to MGL c.44, s31C, I certify that appropriated funds are available for the total amount of this Change Order.

_____ Date: _____

Owner's Auditor/Accountant (Name)

Pursuant to MGL c.30, s39I, reasons for deviation are as stated above or attached. The specified deviation(s) does not materially injure the Project as a whole, the Work is of the same cost and quality or an equitable adjustment has been agreed upon, and the deviation is in the best interest of the Owner.

_____ Date: _____

Owner

A. GENERAL INFORMATION

This document was developed to provide a uniform format for handling contract changes that affect Contract Price or Contract Times. Changes that have been initiated by a Work Change Directive must be incorporated into a subsequent Change Order if they affect Price or Times.

Changes that affect Contract Price or Contract Times should be promptly covered by a Change Order. The practice of accumulating Change Orders to reduce the administrative burden may lead to unnecessary disputes.

If Milestones have been listed in the Agreement, any effect of a Change Order thereon should be addressed.

For supplemental instructions and minor changes not involving a change in the Contract Price or Contract Times, a Field Order should be used.

B. COMPLETING THE CHANGE ORDER FORM

Engineer normally initiates the form, including a description of the changes involved and attachments based upon documents and proposals submitted by Contractor, or requests from Owner, or both.

Once Engineer has completed and signed the form, all copies should be sent to Owner or Contractor for approval, depending on whether the Change Order is a true order to the Contractor or the formalization of a negotiated agreement for a previously performed change. After approval by one contracting party, all copies should be sent to the other party for approval. Engineer should make distribution of executed copies after approval by both parties.

If a change only applies to price or to times, cross out the part of the tabulation that does not apply.

This page intentionally left blank

Notice of Substantial Completion (C-00 65 15)

Project:	Owner:	Owner's Contract No.:
Contract:		Date of Contract:
Contractor:		

This NOTICE of Substantial Completion applies to:

☐ The following Systems, Equipment or specified portions ☐ : All Work under the Contract Documents

:

Date of Substantial Completion for above

The following documents are attached to and made part of this Notice.

Submitted by Contractor

Date

This page intentionally left blank

Certificate of Substantial Completion (Form C-00 65 16)

Project:	
Owner:	Owner's Contract No.:
Contract:	Engineer's Project No.:

This [tentative] [definitive] Certificate of Substantial Completion applies to:

☐ All Work under the Contract Documents: ☐ The following specified portions of the Work:

Date of Substantial Completion

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor, and Engineer, and found to be substantially complete. The Date of Substantial Completion of the Project or portion thereof designated above is hereby declared and is also the date of commencement of applicable warranties required by the Contract Documents, except as stated below.

A [tentative] [definitive] list of items to be completed or corrected is attached hereto. This list may not be all-inclusive, and the failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

The responsibilities between Owner and Contractor for security, operation, safety, maintenance, heat, utilities, insurance and warranties shall be as provided in the Contract Documents except as amended as follows:

☐ Amended Responsibilities ☐ Not Amended

Owner's Amended Responsibilities:

Contractor's Amended Responsibilities:

The following documents are attached to and made part of this Certificate:

This Certificate does not constitute an acceptance of Work not in accordance with the Contract Documents nor is it a release of Contractor's obligation to complete the Work in accordance with the Contract Documents.

Executed by Engineer	Date
Accepted by Contractor	Date
Accepted by Owner	Date

Notice of Completion (Form C-00 65 18)

Project:	Owner:	Owner's Contract No.:
Contract:		Date of Contract:
Contractor:		

This NOTICE of Completion applies to:

☐ All Work under the Contract Documents: ☐ The following specified portions:

Date of final Completion

The Work to which this Notice applies is ready for inspection by authorized representatives of Engineer and Owner. Contractor has completed all corrections, delivered all required documentation, and the Project, or portion designated above, is complete. The Date of Completion of the Project or portion thereof designated above is hereby declared by the Contractor.
.

The following documents are attached to and made part of this Certificate:

Final Punchlist

Final Application for Payment

Only the **making and acceptance of final payment** will constitute:

1. A waiver of all claims by Owner against Contractor, except claims arising from any unsettled liens, from Defective Construction appearing after final inspection; from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and
2. A waiver of all claims by Contractor against Owner other than those previously timely made in writing and still unsettled.

Submitted by Contractor Date

This page intentionally left blank

See various sections of the Supplementary Conditions for additional modifications and supplements

This document has important legal consequences; consultation with an attorney is encouraged with respect to its use or modification. This document should be adapted to the particular circumstances of the contemplated Project and the controlling Laws and Regulations.

SECTION 00 72 05
STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

and

Issued and Published Jointly by

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American Council of Engineering Companies

The Associated General Contractors of America
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ASCE American Society of Civil Engineers

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A Practice Division of the
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Endorsed by

CONSTRUCTION SPECIFICATIONS INSTITUTE

REVISIONS HIGHLIGHTED WITHIN THE TEXT OF THIS SECTION HAVE BEEN PREPARED BY WOODARD & CURRAN

EJCDC C-700 Standard General Conditions of the Construction Contract
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See various sections of the Supplementary Conditions for additional modifications and supplements

These General Conditions have been prepared for use with the Suggested Forms of Agreement Between Owner and Contractor (EJCDC C-520 or C-525, 2007 Editions). Their provisions are interrelated and a change in one may necessitate a change in the other. Comments concerning their usage are contained in the Narrative Guide to the EJCDC Construction Documents (EJCDC C-001, 2007 Edition). For guidance in the preparation of Supplementary Conditions, see Guide to the Preparation of Supplementary Conditions (EJCDC C-800, 2007 Edition).

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SECTION 00 72 05
STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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See various sections of the Supplementary Conditions for additional modifications and supplements

ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

A. Wherever used in the Bidding Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.

2. *Agreement*—The written instrument which is evidence of the agreement between Owner and Contractor covering the Work.

3. *Application for Payment*—The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. *Asbestos*—Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.

5. *Bid*—The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed. May also be referred to as "Proposal" which may be used interchangeably and shall have the same meaning.

6. *Bidder*—The individual or entity who submits a Bid directly to Owner.

7. *Bidding Documents*—The Bidding Requirements and the proposed Contract Documents (including all Addenda).

8. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Supplementary Instructions to Bidders, Bid security of acceptable form, if any, and the Bid Form with any supplements.

9. *Change Order*—A document recommended by Engineer which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.

10. *Claim*—A demand or assertion by Owner or Contractor seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.

11. *Contract*—The entire and integrated written agreement between the Owner and Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

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12. *Contract Documents*—Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents. Approved Shop Drawings, other Contractor submittals, and the reports and drawings of subsurface and physical conditions are not Contract Documents.

13. *Contract Price*—The moneys payable by Owner to Contractor for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of Paragraph 11.03 in the case of Unit Price Work).

14. *Contract Times*—The number of days or the dates stated in the Agreement to: (i) achieve Milestones, if any; (ii) achieve Substantial Completion; and (iii) complete the Work so that it is ready for final payment as evidenced by Engineer's written recommendation of final payment.

15. *Contractor*—The individual or entity with whom Owner has entered into the Agreement.

16. *Cost of the Work*—See Paragraph 11.01 for definition.

17. *Drawings*—That part of the Contract Documents prepared or approved by Engineer which graphically shows the scope, extent, and character of the Work to be performed by Contractor and complement the Specifications. Shop Drawings and other Contractor submittals are not Drawings as so defined. May also be referred to as "Plans", which may be used interchangeably and shall have the same meaning. Notes on Drawings are directed to Contractor unless specifically noted otherwise.

18. *Effective Date of the Agreement*—The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

19. *Engineer*—The individual or entity named as such in the Agreement.

20. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but which does not involve a change in the Contract Price or the Contract Times.

21. *General Requirements*—Sections of Division 01 of the Specifications which govern the Work in all sections of the Specifications.

22. *Hazardous Environmental Condition*—The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto.

23. *Hazardous Waste*—The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.

24. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

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25. *Liens*—Charges, security interests, or encumbrances upon Project funds, real property, or personal property.

26. *Milestone*—A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

27. *Notice of Award*—The written notice by Owner to the Successful Bidder stating that upon timely compliance by the Successful Bidder with the conditions precedent listed therein, Owner will sign and deliver the Agreement.

28. *Notice to Proceed*—A written notice given by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work under the Contract Documents.

29. *Owner*—The individual or entity with whom Contractor has entered into the Agreement and for whom the Work is to be performed.

30. *PCBs*—Polychlorinated biphenyls.

31. *Petroleum*—Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils.

32. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times. May also be referred to as "Construction Schedule", which may be used interchangeably and shall have the same meaning.

33. *Project*—The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part.

34. *Project Manual*—The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.

35. *Radioactive Material*—Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.

36. *Resident Project Representative*—The authorized representative of Engineer who may be assigned to the Site or any part thereof.

37. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.

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38. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements to support scheduled performance of related construction activities.

39. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

40. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.

41. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by Owner which are designated for the use of Contractor.

42. *Specifications*—That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable thereto. The Specifications are based on the guidelines of the Construction Specifications Institute (CSI) Project Resource Manual, and are directed to Contractor unless specifically noted otherwise. The words "shall be" are included by inference where a colon (:) is used within sentences or phrases in the Specifications.

43. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.

44. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

45. *Successful Bidder*—The Bidder submitting a responsive Bid to whom Owner makes an award.

46. *Supplementary Conditions*—That part of the Contract Documents which amends or supplements these General Conditions.

47. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or Subcontractor.

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48. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

49. *Unit Price Work*—Work to be paid for on the basis of unit prices.

50. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.

51. *Work Change Directive*—A written statement to Contractor issued on or after the Effective Date of the Agreement and signed by Owner and recommended by Engineer ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

B. Additional Terms

1. *Final Completion*—The time at which all Work is completed and ready for final payment in accordance with Paragraph 14.07 of these General Conditions.

2. *Industry Practice*—The written practices, methods, materials, supplies and equipment, as changed from time to time, that are commonly used in the industry applicable to the Project to design, construct and operate facilities and plants, or any practices, methods and acts, which in the exercise of reasonable judgment in light of the facts known at the time, could have been expected to accomplish the desired results consistent with good business practices, reliability, safety and expedition.

3. *Installer*—The entity engaged by Contractor or a Subcontractor for installation, erection, application and similar required operations of a particular portion of the Work at the Site, including who has specialty experience in the Work they are engaged to perform.

4. *Punch List*—A list of open items representing portions of the Work which Contractor, Engineer, Owner reasonably agree is not complete on the date of Substantial Completion but which items will not significantly interfere with the safe, reliable operation and integrity of the Project or its intended use.

~~52.~~5. *Purchase Order*—A written agreement between Contractor and a Supplier for provision of material and equipment.

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6. *Warranty Period*—The correction period after the date of Substantial Completion per Paragraph 13.07 of these General Conditions.

1.02 *Terminology*

A. The words and terms discussed in Paragraph 1.02.B through F are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.

B. Intent of Certain Terms or Adjectives:

1. The Contract Documents include the terms "as allowed," "as approved," "as ordered," "as directed" or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives "reasonable," "suitable," "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Paragraph 9.09 or any other provision of the Contract Documents.

C. Day:

1. The word "day" means a calendar day of 24 hours measured from midnight to the next midnight. See also Paragraph 17.02 of these General Conditions.

D. Defective:

1. The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it:

a. does not conform to the Contract Documents; or

b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or

c. has been damaged prior to Engineer's recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 14.04 or 14.05).

E. Furnish, Install, Perform, Provide:

1. The word "furnish," when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

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2. The word "install," when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words "perform" or "provide," when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.

4. When "furnish," "install," "perform," or "provide" is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, "provide" is implied.

F. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 – PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

A. ~~When Contractor delivers the executed counterparts~~Prior to execution of the Agreement ~~to Owner~~, Contractor shall ~~also~~ deliver to Owner such bonds as Contractor may be required to furnish.

B. *Evidence of Insurance:* Prior to execution of the Agreement and b~~B~~efore any Work at the Site is started, Contractor and Owner shall each deliver to the other, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which Contractor and Owner respectively are required to purchase and maintain in accordance with Article 5.

2.02 *Copies of Documents*

A. Owner shall furnish to Contractor up to ~~ten~~ 2 printed or hard copies of the Contract Documents and Drawings ~~and Project Manual~~. Additional copies will be furnished upon request at the cost of reproduction.

2.03 *Commencement of Contract Times; Notice to Proceed*

A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Agreement or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Agreement. In no event will the Contract Times commence to run later than the ~~sixtieth~~ 90th day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, unless mutually agreed otherwise.~~, whichever date is earlier.~~

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2.04 *Starting the Work*

A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to the date on which the Contract Times commence to run.

2.05 *Before Starting Construction*

A. *Preliminary Schedules:* Within 10 days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), Contractor shall submit to Engineer for timely review:

1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents and the lead times for equipment and materials per the listing in subparagraph 2.05.A.4;

2. a preliminary Schedule of Submittals; and

3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work which will be confirmed in writing by Contractor at the time of submission. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work; and.

4. a complete listing of equipment and materials with lead times between placing orders and delivery, including normal allowances of time for processing and correcting Shop Drawings.

B. *Evidence of Insurance*: In accordance with Paragraph 2.01.

2.06 *Preconstruction Conference; Designation of Authorized Representatives*

A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.05.A, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.

B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit instructions, receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

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2.07 *Initial Acceptance of Schedules*

A. At least 10 days before submission of the first Application for Payment a conference attended by Contractor, Engineer, and others as appropriate will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.05.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to component parts of the Work.

4. Contractor's listing of equipment and materials with lead times must be reflected in the Progress Schedule. All orders for long lead items shall be placed within 30 days after Effective Date of the Agreement if delivery is critical to scheduling. Failure to place orders in accordance with the Progress Schedule may result in full liability for liquidated damages if Milestones and Contract Times are not met.

ARTICLE 3 – CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 *Intent*

A. The Contract Documents are complementary; what is required by one is as binding as if required by all and comprise the entire agreement between Owner and Contractor concerning the Work. If any term or provision of any of the Contract Documents, or the application thereof to any party or circumstance shall, to any extent, be determined to be invalid or unenforceable, the remaining provisions of the Contract Documents, or the application of such term or provision to parties or circumstances other than those as to which it is held invalid or unenforceable, shall not be affected thereby, and each term and provision of each of the Contract Documents shall be valid and shall be enforced to the fullest extent permitted by Laws and Regulations.

B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that reasonably may be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the indicated result will be provided whether or not specifically called for, at no additional cost to Owner.

C. Clarifications and interpretations of the Contract Documents shall be issued by Engineer as provided in Article 9.

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3.02 *Reference Standards*

A. Standards, Specifications, Codes, Laws, and Regulations

1. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard, specification, manual, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the Contract Documents. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

3.03 *Reporting and Resolving Discrepancies*

A. Reporting Discrepancies:

1. *Contractor's Review of Contract Documents Before Starting Work*: Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy which Contractor discovers, or has actual knowledge of, and shall obtain a written interpretation or clarification from Engineer before proceeding with any Work affected thereby.

2. *Contractor's Review of Contract Documents During Performance of Work*: If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) any standard, specification, manual, or code, or (c) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in Paragraph 3.04.

3. Contractor shall ~~not~~ be liable to Owner or Engineer for failure to report any such conflict, error, ambiguity, or discrepancy in the Contract Documents ~~unless~~ if Contractor ~~had actual knowledge~~knew or reasonably should have known of such conflict, error, ambiguity, or discrepancy ~~thereof~~.

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B. Resolving Discrepancies:

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:

a. the provisions of any standard, specification, manual, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference in the Contract Documents); or

b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Amending and Supplementing Contract Documents*

A. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof by either a Change Order or a Work Change Directive.

B. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, by one or more of the following ways:

1. A Field Order;

2. Engineer's approval of a Shop Drawing or Sample (subject to the provisions of Paragraph 6.17.D.3); or

3. Engineer's written interpretation or clarification.

3.05 *Reuse of Documents*

A. Contractor and any Subcontractor or Supplier shall not:

1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions; or

2. reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer.

B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

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3.06 *Electronic Data*

A. ~~Unless otherwise stated in the Supplementary Conditions, t~~The data furnished by Owner or Engineer to Contractor, or by Contractor to Owner or Engineer, that may be relied upon are limited to the printed copies (also known as hard copies), files transmitted in in portable document format (PDF), and other electronic media formats of text, data, graphics or other file types supported by any digital document exchange system implemented for the Project, all of which are understood by all parties to constitute official Project correspondence and submittals . ~~Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk.~~ If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.

B. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving party shall be deemed to have accepted the data thus transferred. Any errors detected within the 60-day acceptance period will be corrected by the transferring party.

C. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

ARTICLE 4 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS; REFERENCE POINTS

4.01 *Availability of Lands*

A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work. Owner will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If Contractor and Owner are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, as a result of any delay in Owner's furnishing the Site or a part thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which the Work is to be performed and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

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4.02 *Subsurface and Physical Conditions*

A. *Reports and Drawings:* The Supplementary Conditions identify:

1. those reports known to Owner of explorations and tests of subsurface conditions at or contiguous to the Site; and

2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions, or information.

4.03 *Differing Subsurface or Physical Conditions*

A. *Notice:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed either:

1. is of such a nature as to establish that any "technical data" on which Contractor is entitled to rely as provided in Paragraph 4.02 is materially inaccurate; or

2. is of such a nature as to require a change in the Contract Documents; or

3. differs materially from that shown or indicated in the Contract Documents; or

4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

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then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

B. (Not Used)~~*Engineer's Review*: After receipt of written notice as required by Paragraph 4.03.A, Engineer will promptly review the pertinent condition, determine the necessity of Owner's obtaining additional exploration or tests with respect thereto, and advise Owner in writing (with a copy to Contractor) of Engineer's findings and conclusions.~~

C. Possible Price and Times Adjustments:

1. The Contract Price or the Contract Times, or both, ~~will~~ may be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

   a. such condition must meet any one or more of the categories described in Paragraph 4.03.A; and

   b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraphs 9.07 and 11.03.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times if:

   a. Contractor knew of the existence of such conditions at the time Contractor made a final commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract; or

   b. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such final commitment; ~~or~~

   c. Contractor failed to give the written notice as required by Paragraph 4.03.A,or

   ~~c.~~d. written notice is submitted after final payment.

3. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in Paragraph 10.05. However, neither Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

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4.04 *Underground Facilities*

A. *Shown or Indicated:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

1. Owner and Engineer shall not be responsible for the accuracy or completeness of any such information or data provided by others; and

2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:

a. reviewing and checking all such information and data;

b. locating all Underground Facilities shown or indicated in the Contract Documents;

c. coordination of the Work with the owners of such Underground Facilities, including Owner, during construction; and

d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. Not Shown or Indicated:

1. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer. Engineer will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence or location of the Underground Facility. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

2. If Engineer concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued to reflect and document such consequences. An equitable adjustment shall be made in the Contract Price or Contract Times, or both, to the extent that they are attributable to the existence or location of any Underground Facility that was not shown or indicated ~~or not shown or indicated with reasonable accuracy~~ in the Contract Documents and that Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment in Contract Price or Contract Times, Owner or Contractor may make a Claim therefor as provided in Paragraph 10.05.

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3. Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, shall not be liable to Contractor for any Claims for losses or damages incurred by Contractor related to Underground Facilities not shown or indicated (including but not limited to all fees and changes of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs).

4.05 *Reference Points*

A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.06 *Hazardous Environmental Condition at Site*

A. *Reports and Drawings:* The Supplementary Conditions identify those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at the Site.

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions or information.

C. Contractor shall not be responsible for any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work unless Contractor caused or contributed to such Hazardous Environmental Condition. Contractor shall be responsible for a Hazardous Environmental Condition created with any materials brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible.

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D. If Contractor encounters a Hazardous Environmental Condition or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, Contractor shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 6.16.A); and (iii) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 4.06.E.

E. Contractor shall not be required to resume Work in connection with such condition or in any affected area until after Owner has obtained any required permits related thereto and delivered written notice to Contractor: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, either party may make a Claim therefor as provided in Paragraph 10.05.

F. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of an adjustment in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in Paragraph 10.05. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 7.

G. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition: (i) was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be included within the scope of the Work, and (ii) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.G shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

H. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of

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or relating to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.H shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

I. The provisions of Paragraphs 4.02, 4.03, and 4.04 do not apply to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 5 – BONDS AND INSURANCE

5.01 *Performance, Payment, and Other Bonds*

A. Contractor shall furnish performance and payment bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all of Contractor's obligations under the Contract Documents. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 13.07, whichever is later, except as provided otherwise by Laws or Regulations or by the Contract Documents. Contractor shall also furnish such other bonds as are required by the Contract Documents.

B. All bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All bonds signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed each bond.

C. If the surety on any bond furnished by Contractor is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of Paragraph 5.01.B, Contractor shall promptly notify Owner and Engineer and shall, within ~~20~~ 5 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the requirements of Paragraphs 5.01.B and 5.02.

5.02 *Licensed Sureties and Insurers*

A. All bonds and insurance required by the Contract Documents to be purchased and maintained by Owner or Contractor shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

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5.03 *Certificates of Insurance*

A. Contractor shall deliver to Owner, with copies to each additional insured and loss payee identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Owner or any other additional insured such as a letter from Contractor's insurance company(s) and agents confirming types and limits of coverage) which Contractor is required to purchase and maintain.

B. Owner shall deliver to Contractor, with copies to each additional insured and loss payee identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Contractor or any other additional insured) which Owner is required to purchase and maintain.

C. Failure of Owner to demand such certificates or other evidence of Contractor's full compliance with these insurance requirements or failure of Owner to identify a deficiency in compliance from the evidence provided shall not be construed as a waiver of Contractor's obligation to maintain such insurance.

D. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor.

E. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner in the Contract Documents.

5.04 *Contractor's Insurance*

A. Contractor shall purchase and maintain such insurance as is appropriate for the Work being performed, complies with the requirements of Article 5, and as will provide protection from claims set forth below which may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:

1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;

2. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;

3. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees;

4. claims for damages insured by reasonably available personal injury liability coverage which are sustained:

   a. by any person as a result of an offense directly or indirectly related to the employment of such person by Contractor, or

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b. by any other person for any other reason;

5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; ~~and~~

6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle~~.~~;

7. claims arising out of violation of Laws or Regulations; and

8. claims for damages because of negligent acts, errors and omissions arising out of performing or providing professional services.

B. The policies of insurance required by this Paragraph 5.04 shall:

1. with respect to insurance required by Paragraphs 5.04.A.3 through 5.04.A.~~6~~8 inclusive, be written on an occurrence basis, include as additional insureds (subject to any customary exclusion regarding professional liability) Owner and Engineer, and any other individuals or entities identified in the Supplementary Conditions, all of whom shall be ~~listed~~ included as additional insureds, and include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;

2. include at least the specific coverages and be written for not less than the limits of liability provided herein and in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;

3. include contractual liability insurance covering Contractor's indemnity obligations under Paragraphs 6.11 and 6.20;

4. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until ~~at least 30 days~~ prior written notice has been given to Owner and Contractor and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Contractor pursuant to Paragraph 5.03 will so provide) and will contain waiver provisions in accordance with Paragraph 5.07;

5. remain in effect at least until final payment and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work in accordance with Paragraph 13.07; and

6. include completed operations coverage:

a. Such insurance shall remain in effect for two years after final payment.

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b. Contractor shall furnish Owner and each other additional insured identified in the Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter.

7. In the event general liability insurance is provided on a claims-made policy, the retroactive date of such policy shall not be later than the date of the Notice to Proceed or the Effective Date of the Agreement, whichever is earlier. For construction periods extending beyond the expiration date of an initial claims-made policy, the retroactive date of all subsequent claims-made policies shall not be later than the date of the Notice to Proceed.

C. The limits of liability for the insurance required by Paragraph 5.04 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

1. Workers' Compensation and related coverage:

Minimum limit of liability	Statutory
Applicable Federal (e.g., Longshoreman's)	Statutory
Employer's Liability	$1,000,000

2. Contractor's General Liability:

$1,000,000 per occurrence; $2,000,000 general aggregate; including:

- Broad Form Property Damage Liability including coverage for acts of terrorism
- Completed Operations and Product Liability
- Contractual Liability
- Independent Contractors
- Explosion, Collapse & Underground Hazards
- Personal Injury Coverage, Exclusion Deleted
- Damage to Rented Premises
- Medical Expenses

Pollution Liability (covering third-party injury and property damage claims, including clean-up costs, as a result of pollution conditions arising from the Contractor's operations and completed operations maintained for no less than three years after final completion): $1,000,000

Excess or Umbrella Liability: $5,000,000 per occurrence; $5,000,000 general aggregate

3. Automobile Liability under Paragraph 5.04.A.6 of the General Conditions:

Combined Single Limit of $1,000,000 for bodily injury & property damage covering Contractor and any vehicles owned, hired and non-owned by the Contractor

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See various sections of the Supplementary Conditions for additional modifications and supplements

4. Professional Liability (E&O for engineers, architects or surveyors): $1,000,000 for each claim with an annual aggregate of at least $2,000,000 if professional services are required under the Specifications

5. Owners Protective Liability: as may be specified in the Supplementary Conditions

D. Any self-insured retention (not allowed for Worker's Compensation) and/or deductibles must be identified and cannot exceed $100,000 per occurrence without the prior approval of the Owner. Contractor must provide either an audited financial statement to confirm solvency or a letter of credit guaranteeing the $100,000 in case of loss for the duration of the Project and for the Correction Period.

5.05 *Owner's Liability Insurance*

A. In addition to the insurance required to be provided by Contractor under Paragraph 5.04, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations (ongoing and completed) under the Contract Documents.

5.06 *Property Insurance*

A. ~~Unless otherwise provided in the Supplementary Conditions,~~ Owner may, in its discretion, purchase and maintain property insurance upon the Work at the Site. Contractor shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof. Contractor shall be responsible for any ~~(subject to such~~ deductible amounts or self-insured retention as may be provided in the Supplementary Conditions or required by Laws and Regulations~~)~~. This insurance shall:

1. include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee;

2. be written on a Builder's Risk "all-risk" or Special Forms policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against ~~at least the following~~ special form perils or causes of loss, including but not limited to: fire, lightning, flood, pollution, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage (other than that caused by flood), and such other perils or causes of loss as may be specifically required by the Supplementary Conditions.

3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);

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4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer;

5. allow for partial utilization of the Work by Owner;

6. include testing and startup; and

7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other loss payee to whom a certificate of insurance has been issued; and

~~7.~~8. comply with the requirements of Paragraph 5.06.C of the General Conditions.

B. (Not used)~~Owner shall purchase and maintain such equipment breakdown insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee.~~

C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 5.06 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until ~~at least 30 days~~ prior written notice has been given to Owner and Contractor and to each other loss payee to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with Paragraph 5.07.

D. Owner shall not be responsible for purchasing and maintaining any property insurance specified in this Paragraph 5.06 to protect the interests of Contractor, Subcontractors, or others in the Work. ~~to the extent of any deductible amounts that are identified in the Supplementary Conditions.~~ The risk of loss within such identified deductible amount will be borne by Contractor, Subcontractors, or others suffering any such loss. ~~, and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.~~

E. If Contractor requests in writing that other special insurance be included in the property insurance policies provided under this Paragraph 5.06, Owner shall, if possible, include such insurance, and the cost thereof will be charged to Contractor by appropriate Change Order. Prior to commencement of the Work at the Site, Owner shall in writing advise Contractor whether or not such other insurance has been procured by Owner.

5.07 *Waiver of Rights*

A. Owner and Contractor intend that all policies purchased in accordance with Paragraph 5.06 will protect Owner, Contractor, Subcontractors, and Engineer, and all other individuals or entities identified in the Supplementary Conditions as loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or

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causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or loss payees thereunder. Owner and Contractor waive all rights against each other and their respective officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them for all losses and damages caused by, arising out of or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Subcontractors and Engineer, and all other individuals or entities identified in the Supplementary Conditions as loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner as trustee or otherwise payable under any policy so issued.

B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them for:

1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and

2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial utilization pursuant to Paragraph 14.05, after Substantial Completion pursuant to Paragraph 14.04, or after final payment pursuant to Paragraph 14.07.

C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 5.07.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them.

5.08 *Receipt and Application of Insurance Proceeds* *(Not used)*

~~A. Any insured loss under the policies of insurance required by Paragraph 5.06 will be adjusted with Owner and made payable to Owner as fiduciary for the loss payees, as their interests may appear, subject to the requirements of any applicable mortgage clause and of Paragraph 5.08.B. Owner shall deposit in a separate account any money so received and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof, and the Work and the cost thereof covered by an appropriate Change Order~~.

~~B. Owner as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within 15 days after the occurrence of loss to Owner's exercise of this power. If such objection be made, Owner as fiduciary shall make settlement with~~

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~~the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, Owner as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, Owner as fiduciary shall give bond for the proper performance of such duties.~~

5.09 *Acceptance of Bonds and Insurance; Option to Replace*

A. If ~~either~~ Owner ~~or Contractor~~ has any objection to the coverage afforded by or other provisions of the bonds or insurance required to be purchased and maintained by the ~~other party~~ Contractor in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the ~~objecting party~~Owner shall so notify the ~~other party~~Contractor in writing within 10 days after receipt of the certificates (or other evidence requested) required by Paragraph 2.01.B. ~~Owner and~~ Contractor shall ~~each~~ provide to the ~~other~~ Owner, such additional information in respect of insurance provided as ~~the other~~ may be reasonably requested. If ~~either party~~Contractor does not purchase or maintain all of the bonds and insurance required ~~of such party~~ by the Contract Documents, ~~such party~~Contractor shall notify the ~~other party~~Owner in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the ~~other party~~Owner may elect to obtain equivalent bonds or insurance to protect ~~such other party's~~Owner's interests at the expense of the ~~party~~ Contractor~~who was required to provide such coverage~~, and a Change Order shall be issued to adjust the Contract Price accordingly.

5.10 *Partial Utilization, Acknowledgment of Property Insurer*

A. If Owner finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 14.05, no such use or occupancy shall commence before the insurers providing the property insurance pursuant to Paragraph 5.06 have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy.

ARTICLE 6 – CONTRACTOR'S RESPONSIBILITIES

6.01 *Supervision and Superintendence*

A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction. Contractor shall not be responsible for the negligence of Owner or Engineer in the design or specification of a specific means, method, technique, sequence, or procedure of construction which is shown or indicated in and expressly required by the Contract Documents.

B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

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6.02 *Labor; Working Hours*

A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.

B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours. Contractor will not permit the performance of Work on a Saturday, Sunday, or any legal holiday without Owner's written consent (which will not be unreasonably withheld) given after prior written notice to Engineer.

6.03 *Services, Materials, and Equipment*

A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, startup, and completion of the Work.

B. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

D. Provision of any instructions:

1. will not be effective to assign to Owner, or any of Owner's consultants, agents or employees, any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of Paragraph 8.09; and

2. will not be effective to assign to Engineer, or any of Engineer's consultants, agents or employees, any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of Paragraph 9.09.

6.04 *Progress Schedule*

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.07 as it may be adjusted from time to time as provided below.

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1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.07) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times. Such adjustments will comply with any provisions of the General Requirements applicable thereto.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 12. Adjustments in Contract Times may only be made by a Change Order.

6.05 *Substitutes and "Or-Equals"*

A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item, make or catalogue number, or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or-equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to Engineer for review under the circumstances described below.

1. *"Or-Equal" Items:* If in Engineer's sole discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an "or-equal" item, in which case review and approval of the proposed item may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this Paragraph 6.05.A.1, a proposed item of material or equipment will be considered functionally equal to an item so named if:

a. in the exercise of reasonable judgment Engineer determines that:

1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole; and

3) it has a proven record of performance and availability of responsive service.

b. Contractor certifies that, if approved and incorporated into the Work:

1) there will be no increase in cost to the Owner or increase in Contract Times; and

2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.

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2. Substitute Items:

   a. If in Engineer's sole discretion an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item under Paragraph 6.05.A.1, it will be considered a proposed substitute item.

   b. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor.

   c. The requirements for review by Engineer will be as set forth in Paragraph 6.05.A.2.d, as supplemented by the General Requirements, and as Engineer may decide is appropriate under the circumstances.

   d. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:

      1) shall certify that the proposed substitute item will:

         a) perform adequately the functions and achieve the results called for by the general design,

         b) be similar in substance to that specified, and

         c) be suited to the same use as that specified;

      2) will state:

         a) the extent, if any, to which the use of the proposed substitute item will prejudice Contractor's achievement of Substantial Completion on time,

         b) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and

         c) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty;

      3) will identify:

         a) all variations of the proposed substitute item from that specified, and

         b) available engineering, sales, maintenance, repair, and replacement services; and

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4) shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change.

B. *Substitute Construction Methods or Procedures:* If a specific means, method, technique, sequence, or procedure of construction is expressly required by the Contract Documents, Contractor may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by Engineer. Contractor shall submit sufficient information to allow Engineer, in Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The requirements for review by Engineer will be similar to those provided in Paragraph 6.05.A.2.

C. *Engineer's Evaluation:* Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Paragraphs 6.05.A and 6.05.B. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No "or equal" or substitute will be ordered, installed or utilized until Engineer's review is complete, which will be evidenced by a Change Order in the case of a substitute and an approved Shop Drawing for an "or equal." Engineer will advise Contractor in writing of any negative determination.

D. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.

E. *Engineer's Cost Reimbursement*: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor pursuant to Paragraphs 6.05.A.2 and 6.05.B. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

F. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute or "or-equal" at Contractor's expense.

6.06 *Concerning Subcontractors, Suppliers, and Others*

A. Contractor shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to Owner as indicated in Paragraph 6.06.B), whether initially or as a replacement, against whom Owner may have reasonable objection. Contractor shall not be required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom Contractor has reasonable objection.

B. If the Bidding Requirements or Supplementary Conditions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to Owner in advance for acceptance by Owner by a specified date prior to the Effective Date of the Agreement, and ~~if~~ the Contractor has submitted a list thereof in accordance with the Bidding Requirements or Supplementary Conditions (which shall be included as an attachment to the Agreement), Owner's acceptance (either in writing or by failing to make written objection thereto by the date indicated

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for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of Owner or Engineer to reject defective Work.

C. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents:

1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier or other individual or entity; nor

2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

D. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with Contractor.

E. Contractor shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with Engineer through Contractor.

F. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

G. All Work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer.

1. Whenever any such agreement is with a Subcontractor or Supplier who is listed as a loss payee on the property insurance provided in Paragraph 5.06, the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner, Contractor, Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any

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such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same.

2. Such agreement between Contractor and the Subcontractor or Supplier shall specifically include dispute resolution provisions similar to those in Article 16 (if any) and provisions required by Laws and Regulations identified in the various Supplementary Conditions.

6.07 *Patent Fees and Royalties*

A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.

B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.

C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

D. At the Owner's option, Contractor shall defend claims in connection with any alleged infringement of such rights.

6.08 *Permits*

A. Unless otherwise provided in the Supplementary Conditions, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

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6.09 *Laws and Regulations*

A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.

B. If Contractor observes that the Specifications or Drawings are at variance with any Laws or Regulations, Contractor shall give Engineer prompt written notice thereof, and any necessary changes will be authorized by one of the methods set forth in Paragraph 3.04. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work. However, it shall not be Contractor's responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.

C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids) having an effect on the cost or time of performance of the Work shall be the subject of an adjustment in Contract Price or Contract Times. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

6.10 *Taxes*

A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work, except as may be set forth in the Supplementary Conditions.

6.11 *Use of Site and Other Areas*

A. Limitation on Use of Site and Other Areas:

1. Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof, or of any adjacent land or areas resulting from the performance of the Work.

2. Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.

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3. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused by or based upon Contractor's performance of the Work.

B. *Removal of Debris During Performance of the Work:* During the progress of the Work Contractor shall keep the Site and other areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.

C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work, Contractor shall remove from the Site all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

D. *Loading Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

6.12 *Record Documents*

A. Contractor shall maintain in a safe place at the Site one record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, and written interpretations and clarifications in good order and annotated to show changes made during construction. These record documents together with all approved Samples and a counterpart of all approved Shop Drawings will be available to Engineer for reference. Upon completion of the Work, these record documents, Samples, and Shop Drawings and other closeout submittals specified will be delivered to Engineer for Owner.

6.13 *Safety and Protection*

A. Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

1. all persons on the Site or who may be affected by the Work;

2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and

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3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.

C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs (if any) and other safety requirements that are applicable to the Work.

D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.

E. All damage, injury, or loss to any property referred to in Paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

F. Contractor's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.14 *Safety Representative*

A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

6.15 *Hazard Communication Programs*

A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

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6.16 *Emergencies*

A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

6.17 *Shop Drawings and Samples*

A. Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals (as required by Paragraph 2.07). Each submittal will be identified as Engineer may require.

1. Shop Drawings:

a. Submit number of copies specified in the General Requirements.

b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by Paragraph 6.17.D.

2. Samples:

a. Submit number of Samples specified in the Specifications.

b. Clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 6.17.D.

B. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

C. Submittal Procedures:

1. Before submitting each Shop Drawing or Sample, Contractor shall have:

a. reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;

b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;

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c. determined and verified the suitability of all materials offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review and approval of that submittal.

3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be both a written communication separate from the Shop Drawings or Sample submittal; and, in addition, by a specific notation made on each Shop Drawing or Sample submitted to Engineer for review and approval of each such variation.

D. Engineer's Review:

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

3. Engineer's review and approval shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 6.17.C.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer's review and approval shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 6.17.C.1. or for errors or omissions in a Shop Drawing or Sample.

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E. Resubmittal Procedures:

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.

2. Contractor shall furnish required submittals with sufficient information and accuracy in order to obtain required approval of an item with no more than 3 submittals. Engineer will record Engineer's time for reviewing subsequent submittals of Shop Drawings, samples, or other items requiring approval and Contractor shall reimburse Owner for Engineer's charges for such time.

3. In the event that Contractor requests a change of a previously approved item, Contractor shall reimburse Owner for Engineer's charges for its review time unless the need for such change is beyond the control of Contractor.

6.18 *Continuing the Work*

A. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by Paragraph 15.04 or as Owner and Contractor may otherwise agree in writing.

6.19 *Contractor's General Warranty and Guarantee*

A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and in accordance with Subcontractor warranties, manufacturers and Suppliers warranties on equipment and material, and extended or special warranties and will not be defective for the correction period specified in 13.07. Owner and Engineer and ~~its~~ their officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on representation of Contractor's warranty and guarantee.

1. Contractor shall obtain and preserve for the benefit of the Owner:

a. manufacturers' and Suppliers' written warranties and guarantees on equipment and material incorporated into the Work;

b. written warranties and guarantees from each Subcontractor engaged in the performance of the Work; and

2. extended or special warranties.

B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or

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2. normal wear and tear under normal usage.

C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:

1. observations by Engineer;

2. recommendation by Engineer or payment by Owner of any progress or final payment;

3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;

4. use or occupancy of the Work or any part thereof by Owner;

5. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by Engineer;

6. any inspection, test, or approval by others; ~~or~~

7. any correction of defective Work by Owner; or~~.~~

8. any acceptance by Owner or any failure to do so.

D. Contractor shall prepare and execute a written general warranty and guarantee applicable to the Work reflecting the provisions of this Paragraph 6.19, Article 13 and other applicable provisions of the Contract Documents pertaining to warranties and guarantees, Subcontractor, manufacturers and Supplier warranties and guarantees, and extended or special warranties and guarantees. Contractor shall submit this written general warranty and guarantee in accordance with Article 14 and the General Requirements.

E. Provision of any warranties or guarantees:

1. will not be effective to assign to Owner, or any of Owner's consultants, agents or employees, any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of Paragraph 8.09; and

~~8.~~2. will not be effective to assign to Engineer, or any of Engineer's consultants, agents or employees, any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of Paragraph 9.09.

~~D.~~F. The warranty and guarantee provisions of this Paragraph 6.19 shall be in addition to and not in limitation of any other warranties, guarantees or remedies allowed by Law or required by the Contract Documents.

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6.20 *Indemnification*

A. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify, defend, and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property ~~(other than the Work itself)~~, including the loss of use resulting therefrom but only to the extent caused by any negligent or wrongful act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable .

B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 6.20.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

1. Without limiting the generality of the preceding Paragraph, the Contractor hereby specifically agrees to indemnify, defend, and hold harmless the Owner and Engineer from all such claims, losses or expenses which arise out of injuries of employees of the Contractor or any of its Subcontractors or Suppliers of any tier related to performance of the Work. It is the Owner's intention that all financial risk of injuries related to the Work be borne by the Contractor, and that the Owner have no financial responsibility, direct or indirect, for any such claims.

C. The indemnification obligations of Contractor under Paragraph 6.20.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:

1. the preparation or approval of , ~~or the failure to prepare or approve~~ maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications, provided however, that if the claim, cost, loss or damage referred to in this Paragraph 6.20 results from failure of the Engineer to discover a condition, Underground Facilities or object which is underground or otherwise not reasonably observable by the Engineer, and if said failure to discover either was or should have been apparent to the Contractor in that the said condition or object is omitted from the Engineer's maps, Drawings, opinions, reports, surveys, Change Orders, designs or Specifications, then the Contractor shall be liable for indemnification of the Engineer and Owner under Paragraph 6.20 for claims, costs, losses and damages resulting from said failure to discover unless Contractor shall have notified Engineer of the existence

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and location of such condition or object prior to the occurrence of such claims, costs, losses and damages and in sufficient time for Engineer to have made provisions therefor; or

2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage~~.~~; or

3. caused by the negligent acts, errors or omissions of any of them.

6.21 *Delegation of Professional Design Services*

A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable law.

B. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.

C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.

D. Pursuant to this Paragraph 6.21, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 6.17.D.1.

E. Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents.

ARTICLE 7 – OTHER WORK AT THE SITE

7.01 *Related Work at Site*

A. Owner may perform other work related to the Project at the Site with Owner's employees, or through other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:

1. written notice thereof will be given to Contractor prior to starting any such other work; and

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2. if Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times that should be allowed as a result of such other work, a Claim may be made therefor as provided in Paragraph 10.05.

B. Contractor shall afford each other contractor who is a party to such a direct contract, each utility owner, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and properly coordinate the Work with theirs. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected. ~~The duties and responsibilities of Contractor under this Paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of Contractor in said direct contracts between Owner and such utility owners and other contractors.~~

C. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 7, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

7.02 *Coordination*

A. If Owner intends to contract with others for the performance of other work on the Project at the Site, the following will be set forth in Supplementary Conditions:

1. the individual or entity who will have authority and responsibility for coordination of the activities among the various contractors will be identified;

2. the specific matters to be covered by such authority and responsibility will be itemized; and

3. the extent of such authority and responsibilities will be provided.

B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

7.03 *Legal Relationships*

A. Paragraphs 7.01.A and 7.02 are not applicable for utilities not under the control of Owner.

B. Each other direct contract of Owner under Paragraph 7.01.A shall provide that the other contractor is liable to Owner and Contractor for the reasonable direct delay and disruption costs incurred by Contractor as a result of the other contractor's wrongful actions or inactions.

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C. Contractor shall be liable to Owner and any other contractor under direct contract to Owner for the reasonable direct delay and disruption costs incurred by such other contractor as a result of Contractor's wrongful action or inactions.

ARTICLE 8 – OWNER'S RESPONSIBILITIES

8.01 *Communications to Contractor*

A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

8.02 *Replacement of Engineer*

A. In case of termination of the employment of Engineer, Owner shall appoint an engineer ~~to whom Contractor makes no reasonable objection,~~ whose status under the Contract Documents shall be that of the former Engineer.

8.03 *Furnish Data*

A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

8.04 *Pay When Due*

A. Owner shall make payments to Contractor when they are due as provided in Paragraphs 14.02.C and 14.07.C.

8.05 *Lands and Easements; Reports and Tests*

A. Owner's duties with respect to providing lands and easements and providing engineering surveys to establish reference points are set forth in Paragraphs 4.01 and 4.05. Paragraph 4.02 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of subsurface conditions and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

8.06 *Insurance*

A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 5.

8.07 *Change Orders*

A. Owner is obligated to execute Change Orders as indicated in Paragraph 10.03.

8.08 *Inspections, Tests, and Approvals*

A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 13.03.B.

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8.09 *Limitations on Owner's Responsibilities*

A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. However, the Owner shall have the right to direct the Contractor to perform the Work according to any sequence schedule set forth in the Contract Documents or established pursuant thereto. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

8.10 *Undisclosed Hazardous Environmental Condition*

A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 4.06.

8.11 *Evidence of Financial Arrangements*

A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents.

8.12 *Compliance with Safety Program*

A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed pursuant to Paragraph 6.13.D.

ARTICLE 9 – ENGINEER'S STATUS DURING CONSTRUCTION

9.01 *Owner's Representative*

A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract Documents.

9.02 *Visits to Site*

A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

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B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 9.09. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. However, the Engineer shall have the right to direct the Contractor to perform the Work according to any sequence schedule set forth in the Contract Documents or established pursuant thereto.

9.03 *Project Representative*

A. If Owner and Engineer agree, Engineer will furnish a Resident Project Representative to assist Engineer in providing more extensive observation of the Work. The authority and responsibilities of any such Resident Project Representative and assistants will be as provided ~~in the Supplementary Conditions~~herein, and limitations on the responsibilities thereof will be as provided in Paragraph 9.09. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

B. The Resident Project Representative (RPR) will be Engineer's employee or agent at the Site, will act as directed by and under the supervision of Engineer, and will confer with Engineer regarding RPR's actions. RPR's dealings in matters pertaining to the Work in general shall be with Engineer and Contractor. RPR's dealings with Subcontractors shall be through or with the full knowledge and approval of Contractor. The RPR shall perform the following.

1. *Schedules:* Review the Progress Schedule, schedule of Shop Drawing and Samples submittals, and Schedule of Values prepared by Contractor and consult with Engineer concerning acceptability.

2. *Conferences and Meetings:* Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences and other Project-related meetings, and prepare and circulate copies of minutes thereof.

3. *Liaison*:

   a. Serve as Engineer's liaison with Contractor, working principally through Contractor's authorized representative, to assist in providing information regarding the intent of the Contract Documents.

   b. Assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's on-Site operations.

   c. Assist in obtaining from Owner additional details or information, when required for proper execution of the Work.

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4. *Interpretation of Contract Documents:* Report to Engineer when clarifications and interpretations of the Contract Documents are needed and transmit to Contractor clarifications and interpretations as issued by Engineer.

5. *Shop Drawings and Samples:*

   a. Record date of receipt of Samples and approved Shop Drawings.

   b. Receive Samples which are furnished at the Site by Contractor, and notify Engineer of availability of Samples for examination.

6. *Modifications:*

   a. Consider and evaluate Contractor's suggestions for modifications in Drawings or Specifications and report such suggestions, together with RPR's recommendations, to Engineer.

   b. Transmit to Contractor in writing, decisions as issued by Engineer.

7. *Review of Work and Rejection of Defective Work:*

   a. Conduct onSite observations of Contractor's Work in progress to assist Engineer in determining if the Work is in general proceeding in accordance with the Contract Documents.

   b. Report to Engineer whenever RPR believes that any part of Contractor's Work in progress will not produce a completed Project that conforms generally to the Contract Documents or will imperil the integrity of the design concept of the completed Project as a functioning whole as indicated in the Contract Documents, or has been damaged, or does not meet the requirements of any inspection, test or approval required to be made; and advise Engineer of that part of Work in progress that RPR believes should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection or approval.

8. *Inspections, Tests, and System Startups:*

   a. Verify that tests, equipment, and systems startups and operating and maintenance training are conducted in the presence of appropriate Owner's personnel, and that Contractor maintains adequate records thereof.

   b. Observe, record, and report to Engineer appropriate details relative to the test procedures and systems startups.

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9. *Records:*

   a. Record names, addresses, fax numbers, e-mail addresses, web site locations, and telephone numbers of Contractor, Subcontractors, and major Suppliers.

   b. Maintain records for use in preparing Project documentation.

10. *Reports:*

   a. Furnish periodic reports to Engineer as required of progress of the Work and of Contractor's compliance with the Progress Schedule and schedule of Shop Drawing and Sample submittals.

   b. Draft and recommend to Engineer proposed Change Orders, Work Change Directives, and Field Orders. Obtain backup material from Contractor.

   c. Immediately notify Engineer of the occurrence of any Site accidents, emergencies, acts of God endangering the Work, damage to property by fire or other causes, or the discovery of any Hazardous Environmental Condition or conditions that may impede the compliant operation of existing facilities on Site.

11. *Payment Requests:* Review Applications for Payment with Contractor for compliance with the established procedure for their submission and forward with recommendations to Engineer, noting particularly the relationship of the payment requested to the Schedule of Values, Work completed, and materials and equipment delivered at the Site but not incorporated in the Work.

12. *Certificates, Operation and Maintenance Manuals:* During the course of the Work, verify that materials and equipment certificates, operation and maintenance manuals and other data required by the Specifications to be assembled and furnished by Contractor are applicable to the items actually installed and in accordance with the Contract Documents, and have these documents delivered to Engineer for review and forwarding to Owner prior to payment for that part of the Work.

13. *Completion:*

   a. Participate in a Substantial Completion inspection, assist in the determination of Substantial Completion and the preparation of the Punch List (lists of items to be completed or corrected).

   b. Participate in a final inspection in the company of Engineer, Owner, and Contractor and prepare a final Punch List (list of items to be completed and deficiencies to be remedied).

   c. Observe whether all items on the final Punch List have been completed or corrected and make recommendations to Engineer concerning acceptance and issuance of the Notice of Acceptability of the Work.

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C. The RPR shall not:

1. Authorize any deviation from the Contract Documents or substitution of materials or equipment, including "or-equal" items.

2. Exceed limitations of Engineer's authority as set forth in the Contract Documents.

3. Undertake any of the responsibilities of Contractor, Subcontractors, Suppliers, or Contractor's superintendent.

4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of Contractor's Work unless such advice or directions are specifically required by the Contract Documents.

5. Advise on, issue directions regarding, or assume control over safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor.

6. Participate in specialized field or laboratory tests or inspections conducted off-Site by others except as specifically authorized by Engineer.

7. Accept Shop Drawing or Sample submittals from anyone other than Contractor.

8. Authorize Owner to occupy the Project in whole or in part or determine operational protocol that may affect the compliant operation of existing facilities.

9.04 *Authorized Variations in Work*

A. Engineer may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. These may be accomplished by a Field Order and will be binding on Owner and also on Contractor, who shall perform the Work involved promptly. If Owner or Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, and the parties are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

9.05 *Rejecting Defective Work*

A. Engineer will have authority to reject Work which Engineer believes to be defective, or that Engineer believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Engineer will also have authority to require special inspection or testing of the Work as provided in Paragraph 13.04, whether or not the Work is fabricated, installed, or completed.

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9.06 *Shop Drawings, Change Orders and Payments*

A. In connection with Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, see Paragraph 6.17.

B. In connection with Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, see Paragraph 6.21.

C. In connection with Engineer's authority as to Change Orders, see Articles 10, 11, and 12.

D. In connection with Engineer's authority as to Applications for Payment, see Article 14.

9.07 *Determinations for Unit Price Work*

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of Paragraph 10.05.

9.08 *Decisions on Requirements of Contract Documents and Acceptability of Work*

A. Engineer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to Engineer in writing within 30 days of the event giving rise to the question.

B. Engineer will, with reasonable promptness, render a written decision on the issue referred. If Owner or Contractor believes that any such decision entitles them to an adjustment in the Contract Price or Contract Times or both, a Claim may be made under Paragraph 10.05. The date of Engineer's decision shall be the date of the event giving rise to the issues referenced for the purposes of Paragraph 10.05.B.

C. Engineer's written decision on the issue referred will be final and binding on Owner and Contractor, subject to the provisions of Paragraph 10.05.

D. When functioning as interpreter and judge under this Paragraph 9.08, Engineer will not show partiality to Owner or Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity.

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9.09 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. However, the Engineer shall have the right to direct the Contractor to perform the Work according to any sequence schedule set forth in the Contract Documents or established pursuant thereto. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 14.07.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with, the Contract Documents.

E. The limitations upon authority and responsibility set forth in this Paragraph 9.09 shall also apply to the Resident Project Representative, if any, and assistants, if any.

F. Engineer will have no responsibility or authority:

1. To order changes in construction which will result in additional costs or which will require extensions of Contract Times;

2. To suspend all or any portion of Contractor's operations;

3. To terminate all or any portion of the Work;

4. To make final acceptance of all or any portion of the Work; and

5. To operate or maintain any portion of the Work.

9.10 *Compliance with Safety Program*

A. While at the Site, Engineer's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Engineer has been informed pursuant to Paragraph 6.13.D.

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ARTICLE 10 – CHANGES IN THE WORK; CLAIMS

10.01 *Authorized Changes in the Work*

A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work by a Change Order, or a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

B. If Owner and Contractor are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made therefor as provided in Paragraph 10.05.

10.02 *Unauthorized Changes in the Work*

A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents as amended, modified, or supplemented as provided in Paragraph 3.04, except in the case of an emergency as provided in Paragraph 6.16 or in the case of uncovering Work as provided in Paragraph 13.04.D.

10.03 *Execution of Change Orders*

A. Owner and Contractor shall execute appropriate Change Orders recommended by Engineer covering:

1. changes in the Work which are: (i) ordered by Owner pursuant to Paragraph 10.01.A, (ii) required because of acceptance of defective Work under Paragraph 13.08.A or Owner's correction of defective Work under Paragraph 13.09, or (iii) agreed to by the parties;

2. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive; and

3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by Engineer pursuant to Paragraph 10.05; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the Progress Schedule as provided in Paragraph 6.18.A.

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10.04 *Notification to Surety*

A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

10.05 *Claims*

A. *Engineer's Decision Required*: All Claims, except those waived pursuant to Paragraph 14.09, shall be referred to the Engineer for decision. A decision by Engineer shall be required as a condition precedent to any exercise by Owner or Contractor of any rights or remedies either may otherwise have under the Contract Documents or by Laws and Regulations in respect of such Claims.

B. *Notice:* Written notice stating the general nature of each Claim shall be delivered by the claimant to Engineer and the other party to the Contract promptly (but in no event later than ~~30~~ 14 days) after the start of the event giving rise thereto. Failure to comply with this notice requirement shall constitute a waiver of the Claim. The responsibility to substantiate a Claim shall rest with the party making the Claim. Notice of the amount or extent of the Claim, with supporting data shall be delivered to the Engineer and the other party to the Contract within ~~60~~ 30 days after the start of such event (unless Engineer allows additional time for claimant to submit additional or more accurate data in support of such Claim). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of Paragraph 12.01.B. A Claim for an adjustment in Contract Times shall be prepared in accordance with the provisions of Paragraph 12.02.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The opposing party shall submit any response to Engineer and the claimant within 30 days after receipt of the claimant's last submittal (unless Engineer allows additional time).

C. *Engineer's Action*: Engineer will review each Claim and, within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any, take one of the following actions in writing:

1. deny the Claim in whole or in part;

2. approve the Claim; or

3. notify the parties that the Engineer is unable to resolve the Claim if, in the Engineer's sole discretion, it would be inappropriate for the Engineer to do so. For purposes of further resolution of the Claim, such notice shall be deemed a denial.

D. In the event that Engineer does not take action on a Claim within said 30 days, the Claim shall be deemed denied.

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E. Engineer's written action under Paragraph 10.05.C or denial pursuant to Paragraphs 10.05.C.3 or 10.05.D will be final and binding upon Owner and Contractor, unless Owner or Contractor invoke the dispute resolution procedure set forth in Article 16 within 30 days of such action or denial.

F. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this Paragraph 10.05.

G. Contractor shall not have the right to stop performance of the Work pending resolution of a Claim.

ARTICLE 11 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

11.01 *Cost of the Work*

A. *Costs Included:* The term Cost of the Work means the sum of all costs, except those excluded in Paragraph 11.01.B, necessarily incurred and paid by Contractor in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to Contractor will be only those additional or incremental costs required because of the change in the Work or because of the event giving rise to the Claim. Except as otherwise may be agreed to in writing by Owner, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 11.01.B, and shall include only the following items:

1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.

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3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 11.01.

4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.

5. Supplemental costs including the following:

    a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.

    b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.

    c. Rentals of all construction equipment and machinery, and the parts thereof whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work. Small tools and manual equipment are not allowable and considered to be included in overhead.

        1) Rentals of construction equipment and machinery and the parts thereof whether rented from Contractor or others in accordance with rates published in current edition of the Rental Rate Blue Book® for construction equipment published by EquipmentWatch® (www.equipmentwatch.com). When Contractor-owned equipment is ordered by Owner or Engineer to be held at standby, equipment rental rates shall be 50% of normal rate. Rental or standby shall not include time that equipment is inoperative because of malfunction or breakdown and shall cease when the use thereof is no longer necessary for the Work. The rental rate, shall be determined as follows.

            a) For equipment already on the Project: the monthly prorated rental rate by hourly use.

            b) For equipment not on the Project: most cost effective daily, weekly or monthly rate. 1 month normal use = 176 hours.

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d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.

e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 5.06.D), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.

g. The cost of utilities, fuel, and sanitary facilities at the Site.

h. Minor expenses such as telegrams, long distance telephone calls, telephone service at the Site, express and courier services, and similar petty cash items in connection with the Work.

i. The costs of premiums for all bonds and insurance Contractor is required by the Contract Documents to purchase and maintain.

B. *Costs Excluded:* The term Cost of the Work shall not include any of the following items:

1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 11.01.A.1 or specifically covered by Paragraph 11.01.A.4, all of which are to be considered administrative costs covered by the Contractor's fee.

2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.

3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.

4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

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5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraphs 11.01.A.

C. *Contractor's Fee:* When all the Work is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 12.01.C.

D. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to Paragraphs 11.01.A and 11.01.B, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

11.02 *Allowances*

A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.

B. Cash Allowances: (Not used)

~~1. Contractor agrees that:~~

~~a. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and~~

~~b. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.~~

C. Owner's Contingency Allowances:

1. Contractor agrees that Owner's ~~a~~ contingency allowance, if any, is for the sole use of Owner to cover ~~un~~estimated anticipated costs for certain items.

D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by Owner's contingency allowances, and the Contract Price shall be correspondingly adjusted. Contractor shall not receive payment for any unused portion of the contingency allowance.

11.03 *Unit Price Work*

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

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B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by Contractor will be made by Engineer subject to the provisions of Paragraph 9.07.

C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

~~D. Owner or Contractor may make a Claim for an adjustment in the Contract Price in accordance with Paragraph 10.05 if:~~

~~1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and~~

~~2. there is no corresponding adjustment with respect to any other item of Work; and~~

~~3. Contractor believes that Contractor is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.~~

ARTICLE 12 – CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

12.01 *Change of Contract Price*

A. The Contract Price may only be changed by a Change Order. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.

B. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:

1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 11.03); or

2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 12.01.C.2); or

3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under Paragraph 12.01.B.2, on the basis of the Cost of the Work (determined as provided in Paragraph 11.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 12.01.C).

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C. *Contractor's Fee:* The Contractor's fee for overhead and profit shall be determined as follows:

1. a mutually acceptable fixed fee; or

2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

   a. for costs incurred under Paragraphs 11.01.A.1 and 11.01.A.2, the Contractor's fee shall be ~~15~~ 10 percent;

   b. for costs incurred under Paragraph 11.01.A.3, the Contractor's fee shall be five percent;

   c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 12.01.C.2.a and 12.01.C.2.b is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of ~~15~~ 10 percent of the costs incurred by such Subcontractor under Paragraphs 11.01.A.1 and 11.01.A.2 and that any higher tier Subcontractor and Contractor will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor, provided, however, that on any subcontracted work the total maximum fee to be paid by Owner under this subparagraph shall be no greater than 27 percent of the costs incurred by the Subcontractor who actually performs the Work;

   d. no fee shall be payable on the basis of costs itemized under Paragraphs 11.01.A.4, 11.01.A.5, and 11.01.B;

   e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and

   f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 12.01.C.2.a through 12.01.C.2.e, inclusive.

12.02 *Change of Contract Times*

A. The Contract Times may only be changed by a Change Order. Any Claim for an adjustment in the Contract Times shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.

B. Any adjustment of the Contract Times covered by a Change Order or any Claim for an adjustment in the Contract Times will be determined in accordance with the provisions of this Article 12.

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12.03 *Delays*

A. Where Contractor is prevented from completing any part of the Work within the Contract Times due to delay beyond the control of Contractor, the Contract Times will be extended in an amount equal to the time lost due to such delay if a Claim is made therefor as provided in Paragraph 12.02.A. Delays beyond the control of Contractor shall include, but not be limited to, acts or neglect by Owner, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions, acts of war or terrorism, or acts of God (force majeure).

B. If Owner, Engineer, or other contractors or utility owners performing other work for Owner as contemplated by Article 7, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

C. If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of war or terrorism, acts of God, acts or failures to act of utility owners not under the control of Owner, or other causes not the fault of and beyond control of Owner and Contractor, then Contractor shall be entitled to an equitable adjustment in Contract Times, if such adjustment is essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays described in this Paragraph 12.03.C.

D. Owner, Engineer, and their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

E. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

ARTICLE 13 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

13.01 *Notice of Defects*

A. Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor. Defective Work may be rejected, corrected, or accepted as provided in this Article 13.

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13.02 *Access to Work*

A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and governmental agencies with jurisdictional interests will have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

13.03 *Tests and Inspections*

A. Contractor shall give Engineer timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

B. (Not Used)~~Owner shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:~~

~~1. for inspections, tests, or approvals covered by Paragraphs 13.03.C and 13.03.D below;~~

~~2. that costs incurred in connection with tests or inspections conducted pursuant to Paragraph 13.04.B shall be paid as provided in Paragraph 13.04.C; and~~

~~3. as otherwise specifically provided in the Contract Documents.~~

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

D. Except where responsibility for a specific inspection or test is expressly allocated to Owner in the Specifications or by Laws and Regulations, Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and Engineer.

E. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation.

F. Uncovering Work as provided in Paragraph 13.03.E shall be at Contractor's expense. ~~unless Contractor has given Engineer timely notice of Contractor's intention to cover the same and Engineer has not acted with reasonable promptness in response to such notice.~~

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13.04 *Uncovering Work*

A. If any Work is covered contrary to the written request of Engineer, it must, if requested by Engineer, be uncovered for Engineer's observation and replaced at Contractor's expense.

B. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment.

C. If it is found that the uncovered Work is defective, Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05.

D. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

13.05 *Owner May Stop the Work*

A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

13.06 *Correction or Removal of Defective Work*

A. Promptly after receipt of written notice, Contractor shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by Engineer, remove it from the Project and replace it with Work that is not defective. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).

B. When correcting defective Work under the terms of this Paragraph 13.06 or Paragraph 13.07, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

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13.07 *Correction Period*

A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents) or by any specific provision of the Contract Documents, any Work is found to be defective, or if the repair of any damages to the land or areas made available for Contractor's use by Owner or permitted by Laws and Regulations as contemplated in Paragraph 6.11.A is found to be defective, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. repair such defective land or areas; or

2. correct such defective Work; or

3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and

4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom.

B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by Contractor and may be deducted from amounts otherwise due the Contractor.

C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.

D. Where defective Work, including materials, equipment and supplies or as defined in manufacturers' and Suppliers' warranties (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this Paragraph 13.07, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed and the terms of this Paragraph 13.07 will continue to apply.

E. Contractor's obligations under this Paragraph 13.07 are in addition to any other obligation or warranty. The provisions of this Paragraph 13.07 shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

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13.08 *Acceptance of Defective Work*

A. If, instead of requiring correction or removal and replacement of defective Work, Owner (and, prior to Engineer's recommendation of final payment, Engineer) prefers to accept it, Owner may do so. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness) and for the diminished value of the Work to the extent not otherwise paid by Contractor pursuant to this sentence. If any such acceptance occurs prior to Engineer's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and Owner shall be entitled to an appropriate decrease in the Contract Price, reflecting the diminished value of Work so accepted. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05. If the acceptance occurs after such recommendation, an appropriate amount will be paid by Contractor to Owner.

13.09 *Owner May Correct Defective Work*

A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer in accordance with Paragraph 13.06.A, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, Owner may, after seven days written notice to Contractor, or immediately in the case of an emergency, correct, or remedy any such deficiency.

B. In exercising the rights and remedies under this Paragraph 13.09, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, take possession of Contractor's tools, appliances, construction equipment and machinery at the Site, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this Paragraph.

C. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 13.09 will be charged against Contractor, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount of the adjustment, Owner may make a Claim therefor as provided in Paragraph 10.05. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

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D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 13.09.

ARTICLE 14 – PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 *Schedule of Values*

A. The Schedule of Values established as provided in Paragraph 2.07.A will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed.

14.02 *Progress Payments*

A. Applications for Payments:

1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

B. Review of Applications:

1. Engineer will, within 10 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to Owner or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.

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2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

    a. the Work has progressed to the point indicated;

    b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 9.07, and any other qualifications stated in the recommendation); and

    c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.

3. By recommending any such payment Engineer will not thereby be deemed to have represented that:

    a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract Documents; or

    b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:

    a. to supervise, direct, or control the Work, or

    b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or

    c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or

    d. to make any examination to ascertain how or for what purposes Contractor has used the moneys paid on account of the Contract Price, or

    e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.

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5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 14.02.B.2. Engineer may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:

    a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;

    b. the Contract Price has been reduced by Change Orders;

    c. Owner has been required to correct defective Work or complete Work in accordance with Paragraph 13.09; or

    d. Engineer has actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.02.A.

C. Payment Becomes Due:

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended will (subject to the provisions of Paragraph 14.02.D) become due, and when due will be paid by Owner to Contractor.

D. Reduction in Payment:

1. Owner may refuse to make payment of the full amount recommended by Engineer because:

    a. claims have been made against Owner on account of Contractor's performance or furnishing of the Work;

    b. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens and provides an indemnity satisfactory to Owner for all claims, costs, losses and damages arising out of such Liens;

    c. there are other items entitling Owner to a set-off against the amount recommended including liability for liquidated damages and correction of defective work by Owner or others; or

    d. Owner has actual knowledge of the occurrence of any of the events enumerated in Paragraphs 14.02.B.5.a through 14.02.B.5.c or Paragraph 15.02.A.

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2. If Owner refuses to make payment of the full amount recommended by Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, when Contractor remedies the reasons for such action.

3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 14.02.C.1 and subject to interest as provided in the Agreement.

14.03 *Contractor's Warranty of Title*

A. Contractor warrants and guarantees that title to all Work, materials, and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to Owner no later than the time of payment free and clear of all Liens.

14.04 *Substantial Completion*

A. When Contractor considers the entire Work ready for its intended use and final testing has been completed in accordance with the General Requirements, Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete (except for items specifically listed by Contractor in the Punchlist as incomplete) using the Notice of Substantial Completion form included in the Contract Documents, submit the Contractor's written general warranty and guarantee per Paragraph 6.19.D., and request that Engineer issue a certificate of Substantial Completion.

B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.

C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion using the Certificate of Substantial Completion included in the Contract Documents. There shall be attached to the certificate a Punch List (tentative list of items to be completed or corrected before final payment). Owner shall have seven days after receipt of the tentative certificate during which to make written objection to Engineer as to any provisions of the certificate or attached list. If, after considering such objections, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the tentative certificate to Owner, notify Contractor in writing, stating the reasons therefor. If, after consideration of Owner's objections, Engineer considers the Work substantially complete, Engineer will, within said 14 days, execute and deliver to Owner and Contractor a definitive certificate of Substantial Completion (with a revised Punch List (tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as Engineer believes justified after consideration of any objections from Owner.

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D. At the time of delivery of the tentative certificate of Substantial Completion, Engineer will deliver to Owner and Contractor a written recommendation as to division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, and protection of the Work, maintenance, heat, utilities, insurance, and warranties and guarantees. Unless Owner and Contractor agree otherwise in writing and so inform Engineer in writing prior to Engineer's issuing the definitive certificate of Substantial Completion, Engineer's aforesaid recommendation will be binding on Owner and Contractor until final payment.

E. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the ~~tentative list~~Punch List.

14.05 *Partial Utilization*

A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. Owner at any time may request Contractor in writing to permit Owner to use or occupy any such part of the Work which Owner believes to be ready for its intended use and substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 14.04.A through D for that part of the Work.

2. Contractor at any time may notify Owner and Engineer in writing that Contractor considers any such part of the Work ready for its intended use and substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 14.04 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 5.10 regarding property insurance.

B. Owner may request in writing that Contractor permit Owner to separately operate any part of the Work although it is not substantially complete subject to the following conditions.

1. A copy of such request will be sent to Engineer and, within a reasonable time thereafter, Owner, Contractor and Engineer shall make an inspection of that part of the Work not substantially complete to determine the status of completion and will prepare a Punch List before final payment.

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2. If Contractor does not indicate in writing to Owner and Engineer that such part of the Work is not ready for separate operation by Owner, Engineer will finalize the Punch List and will deliver such list to Owner and Contractor, together with a written recommendation as to the division of responsibilities between Owner and Contractor with respect to security, operation, safety, maintenance, utilities, insurance, warranties and guarantees for that part of the Work pending final payment.

3. The Engineer's recommendation and Punch List will become binding upon Owner and Contractor at the time the Owner takes over and separately operates such part of the Work unless otherwise agreed in writing and so informed Engineer.

4. During such separate operation by Owner and prior to Substantial Completion of such part of the Work, Owner shall allow Contractor reasonable access to complete or correct Punch List and to complete other related Work.

14.06 *Final Inspection*

A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

14.07 *Final Payment*

A. Application for Payment:

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, warranties, updated Contractor's written general warranty and guarantee per Paragraph 6.19.D if modified, bonds, certificates or other evidence of insurance, certificates of inspection, marked-up record documents (as provided in Paragraph 6.12), and other documents, and Engineer has indicated that the Work is acceptable (subject to the provisions of Paragraph 14.09), Contractor may make application for final payment following the procedure for progress payments.

2. The final Application for Payment shall be accompanied (except as previously delivered) by:

a. all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by Paragraph 5.04.B.6;

b. consent of the surety, if any, to final payment;

c. a list of all Claims against Owner that Contractor believes are unsettled;

~~c.~~d. Notice of Completion; and

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~~d.~~e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of or Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in Paragraph 14.07.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (i) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (ii) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien.

B. Engineer's Review of Application and Acceptance:

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract Documents have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of payment and present the Application for Payment to Owner for payment. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of Paragraph 14.09. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. Payment Becomes Due:

1. Thirty days after the presentation to Owner of the Application for Payment and accompanying documentation, the amount recommended by Engineer, less any sum Owner is entitled to set off against Engineer's recommendation, including but not limited to liquidated damages, will become due and will be paid by Owner to Contractor.

14.08 *Final Completion Delayed*

A. If, through no fault of Contractor, final completion of the Work is significantly delayed, and if Engineer so confirms, Owner shall, upon receipt of Contractor's final Application for Payment (for Work fully completed and accepted) and recommendation of Engineer, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted as detailed on the Notice of Completion. If the remaining balance to be held by Owner for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if bonds have been furnished as required in Paragraph 5.01, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by Contractor to Engineer with the Application for

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such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

14.09 *Waiver of Claims*

A. The making and acceptance of final payment will constitute:

1. a waiver of all Claims by Owner against Contractor, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and

2. a waiver of all Claims by Contractor against Owner other than those previously made in accordance with the requirements herein and expressly acknowledged by Owner in writing as still unsettled.

ARTICLE 15 – SUSPENSION OF WORK AND TERMINATION

15.01 *Owner May Suspend Work*

A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by notice in writing to Contractor and Engineer which will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be granted an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if Contractor makes a Claim therefor as provided in Paragraph 10.05.

15.02 *Owner May Terminate for Cause*

A. The occurrence of any one or more of the following events will justify termination for cause:

1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule established under Paragraph 2.07 as adjusted from time to time pursuant to Paragraph 6.04);

2. Contractor's disregard of Laws or Regulations of any public body having jurisdiction;

3. Contractor's repeated disregard of the authority of Engineer; or

4. Contractor's violation in any substantial way of any provisions of the Contract Documents; or

5. Contractor commences a voluntary case under any chapter of the Bankruptcy Code (Title 11, United States Code), as now or hereafter in effect, or if Contractor takes any equivalent or similar action by filing a petition or otherwise under any Laws and Regulations in effect at such time relating to the bankruptcy or insolvency; or

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6. a petition is filed against Contractor under any chapter of the Bankruptcy Code as now or hereafter in effect at the time of filing, or if a petition is filed seeking any such equivalent or similar relief against Contractor under any Laws and Regulations in effect at the time relating to bankruptcy or insolvency; or

7. Contractor makes a general assignment for the benefit of creditors; or

8. a trustee, receiver, custodian or agent of Contractor is appointed under applicable law or under contract, whose appointment or authority to take charge of property of Contractor is for the purpose of enforcing a Lien against such property or for the purpose of general administration of such property for the benefit of Contractor's creditors; or

9. Contractor admits in writing its inability to pay its debts generally as they become due.

B. If one or more of the events identified in Paragraph 15.02.A occur, Owner may, after giving Contractor (and surety) seven days written notice of its intent to terminate the services of Contractor:

1. exclude Contractor from the Site, and take possession of the Work and of all Contractor's tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion);

2. incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere; and

3. complete the Work as Owner may deem expedient.

C. If Owner proceeds as provided in Paragraph 15.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Owner arising out of or relating to completing the Work, such excess will be paid to Contractor. If such claims, costs, losses, and damages exceed such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this Paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

D. Notwithstanding Paragraphs 15.02.B and 15.02.C, Contractor's services will not be terminated if Contractor begins within seven days of receipt of notice of intent to terminate to correct its failure to perform and proceeds diligently to cure such failure within no more than 30 days of receipt of said notice.

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E. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue. Any retention or payment of moneys due Contractor by Owner will not release Contractor from liability.

F. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 5.01.A, the termination procedures of that bond shall supersede the provisions of Paragraphs 15.02.B and 15.02.C.

15.03 *Owner May Terminate For Convenience*

A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;

3. ~~all~~ reasonable claims, costs, losses, and damages (including but not limited to ~~all~~ reasonable fees and charges of engineers, architects, attorneys, and other professionals and ~~all~~ reasonable court or arbitration or other dispute resolution costs) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and

4. reasonable expenses directly attributable to termination.

B. Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

15.04 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (i) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (ii) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (iii) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the Contract and recover from Owner payment on the same terms as provided in Paragraph 15.03.

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B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this Paragraph 15.04 are not intended to preclude Contractor from making a Claim under Paragraph 10.05 for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this Paragraph.

ARTICLE 16 – DISPUTE RESOLUTION

16.01 *Methods and Procedures*

A. Subject to the requirements in Paragraph 10.05, Owner and Contractor shall attempt in good faith to resolve all unsettled Claims, counterclaims, disputes and other matters in question between them arising out of or relating to the Contract Documents ("Disputes") promptly by negotiation, as follows. All negotiations pursuant to this clause are confidential and shall be treated as compromise and settlement negotiations for purposes of the Federal Rules of Evidence and state Rules of Evidence.

1. Either party may give the other party written notice of any Dispute not resolved.

2. Managers of both parties at levels at least one level above the Project personnel involved in the dispute shall meet at a mutually acceptable time and place within 5 business days after delivery of such notice, and thereafter as often as they reasonably deem necessary, to exchange relevant information and to attempt to resolve the Dispute.

3. If the matter has not been resolved within 30 days from the referral of the Dispute to the managers, or if no meeting has taken place within 10 days after such referral, either party may initiate mediation as provided hereinafter.

~~A.~~B. Subject to Paragraph 16.01.A, e~~E~~ither Owner or Contractor may request mediation of any Claim submitted to Engineer for a decision under Paragraph 10.05 before such decision becomes final and binding. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract. Timely submission of the request shall stay the effect of Paragraph 10.05.E.

~~B.~~C. Owner and Contractor shall participate in the mediation process in good faith. The process shall be concluded within 60 days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.

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~~C.~~D. If the Claim is not resolved by mediation, Engineer's action under Paragraph 10.05.C or a denial pursuant to Paragraphs 10.05.C.3 or 10.05.D shall become final and binding 30 days after termination of the mediation unless, within that time period, Owner or Contractor:

1. elects in writing to invoke any dispute resolution process provided for in the Supplementary Conditions; or

2. agrees with the other party to submit the Claim to another dispute resolution process; or

3. gives written notice to the other party of the intent to submit the Claim to a court of competent jurisdiction.

ARTICLE 17 – MISCELLANEOUS

17.01 *Giving Notice*

A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:

1. delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended; or

2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

17.02 *Computation of Times*

A. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

17.03 *Cumulative Remedies*

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract Documents. The provisions of this Paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

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17.04 *Survival of Obligations*

A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

17.05 *Controlling Law*

A. This Contract is to be governed by the law of the state in which the Project is located.

17.06 *Headings*

A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

17.07 *Professional Fees and Court Costs Included*

A. In any action or proceeding to enforce or interpret any contractual provision or to resolve any conflict or dispute relating to or arising from this Contract, the prevailing party shall be entitled to recover, as part of its claim, award or judgment, reasonable attorneys; fees and associated costs and expenses, including expenses of engineering, claims and other consultants.

END OF SECTION

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SECTION 00 73 10

GENERAL SUPPLEMENTARY CONDITIONS

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract, EJCDC® C-700 (2007 Edition) included in Section 00 72 05. All provisions that are not so amended or supplemented remain in full force and effect unless amended or supplemented in another Section. The terms used in these Supplementary Conditions have the meanings stated in the General Conditions. Additional terms used in this Section have the meanings stated below, if any, which are applicable to both the singular and plural thereof. The address system used herein is the same as the address system used in the General Conditions, with the prefix "SC" added thereto.

This Section may include certain provisions required by Laws and Regulations but does not represent or reflect all applicable provisions and policies or Laws and Regulations and may only include excerpts and portions thereof. Other required provisions and policies, and Laws and Regulations, shall be deemed to be so included and incorporated herein. Contractor is solely responsible to determine, obtain, review and interpret the full text of applicable provisions and policies, Regulations, and Laws.

SC-2.05 *Before Starting Construction*

Pursuant to subparagraph 2.05.A.1 regarding Progress Schedule, do not include weekends in Work hours.

Pursuant to subparagraph 2.05.A.3 regarding the Schedule of Values, the prices in the Bid Form will constitute the minimum items for the preliminary Schedule of Values for this Project.

Add the following immediately after Paragraph 2.05.B.

C. Additionally, within 10 days after the Effective Date of the Agreement, Contractor shall submit a Construction Operations Plan incorporating the schedules submitted pursuant to Paragraph 2.05.A and covering the following.

1. Coordination of Supplier/manufacturer’s expected equipment lead times with mobilization

2. Construction methods and sequence of operations

3. Proposed Site access

4. Proposed erosion control measures and proposed measures to minimize impacts to existing vegetation and impacts to water quality in compliance with the General Requirements

D. Within 30 calendar days of the Notice to Proceed, submit the plan detailed in Section 01 15 20 to maintain pump station operation.

SC-2.07 ***Initial Acceptance of Schedules***

Add the following immediately after subparagraph 2.07.A.4.

5. Contractor's Construction Operations Plan submitted pursuant to Paragraph 2.05.C. will be acceptable to Engineer if it accurately and reasonably addresses all aspects of the Work.

SC 4.01 ***Availability of Lands***

Pursuant to Paragraph 4.01.A, a permanent easement exists as shown in the Drawings.

SC-4.02 ***Subsurface and Physical Conditions***

Pursuant to Paragraph 4.02.A,

1. the following reports of explorations and tests of subsurface conditions at or contiguous to the Site are known to Owner:

   a. NONE

2. The following drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) are known to Owner:

   a. NONE

SC-4.05 ***Reference Points***

Pursuant to Paragraph 4.05.A, no surveys exist for the Project.

SC-4.06 ***Hazardous Environmental Conditions at Site***

Pursuant to Paragraph 4.06.A,

1. the following reports regarding Hazardous Environmental Conditions at the Site are known to Owner:

   a. NONE

2. The following drawings regarding Hazardous Environmental Conditions at the Site are known to Owner:

   a. NONE

SC-5.04 ***Contractor's Insurance***

Pursuant to Paragraph 5.04.A, in addition to the individuals and entities specified in subparagraph 5.04.B.1, include the following as loss payees.

NONE

SC-5.06 ***Property Insurance***

Replace subparagraph 5.06.A.2 in its entirety with the following.

2. be written on a Builder's Risk "all-risk"/Special Forms policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against the following special form perils or causes of loss, including but not limited to: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage, and such other perils or causes of loss as may be specifically required by the Supplementary Conditions.

SC-6.02 ***Labor; Working Hours***

Add the following immediately after Paragraph 6.02.B.

1. Regular working hours for this Project are 7:00AM to 3:00PM, Monday through Friday.

2. Work on weekends and holidays is not permitted.

3. Notify Owner in advance if it is necessary to work more than 8 hours in one day.

SC-6.08 ***Permits***

Add the following immediately after Paragraph 6.08.A.

1. All permit fees will be waived by the Town of Tewksbury, MA.

B. Owner has not obtained any permits for the Project.

SC-6.09 ***Laws and Regulations***

Add the following immediately after Paragraph 6.09.C.

D. Contractor shall allow access to the Site and Project records by authorized local, State, and Federal agencies and representatives.

SC-6.13 ***Safety and Protection***

Add the following immediately after Paragraph 6.13.B.

1. Contractor shall comply with the following minimum requirements and is solely responsible to determine, obtain, review and interpret the full text of applicable Laws and Regulations.

    - Hazard Communication Standard 1910.1200 regulated by OSHA, including providing and maintaining Safety Data Sheets, labeling of hazardous substances, and providing required protective equipment and training and instruction to personnel on the Site including Owner and Engineer's personnel
    - Code of Federal Regulations, Chapter XVII-Occupational Safety and Health Administration (OSHA), Department of Labor, Title 29, Part 1926, Safety and Health Regulations for Construction
        - 1926 Subpart AA Confined Spaces in Construction
    - ANSI/ASSE A10 series of safety construction standards including the "Manual of Accident Prevention In Construction" published by The Associated General Contractors of America
    - AASHTO Guide on Occupational Safety on Highway Construction Projects, Subpart N, 1926.550, relating to protection of personnel and equipment under electric lines and construction equipment clearances at overhead electric lines especially during operations using large vehicles

SC-7.01 ***Related Work at Site***

Pursuant to Paragraph 7.01, Owner has not separately contracted for other work on the Project at the Site.

SC-9.01 ***Owner's Representative***

Add the following immediately after Paragraph 9.01.A.

B. Nothing contained in the Contract Documents shall be construed to create a contractual relationship of any kind between the Engineer and Contractor, or between any person or entities other than the Owner and Contractor. The Engineer shall, however, be entitled to performance and enforcement of obligations under the Contract Documents intended to facilitate performance of the Engineer's duties.

SC-14.02 ***Progress Payments***

Add the following language at the end of subparagraph 14.02.C.1.

> For the purposes of this Paragraph, "Owner" shall mean "Owner's approving authorities".

SC-14.07 ***Final Payment***

Add the following language at the end of subparagraph 14.07.C.1.

> For the purposes of this Paragraph, "Owner" shall mean "Owner's approving authorities".

SC-16 DISPUTE RESOLUTION

Add the following immediately after Paragraph 16.01.D.

16.02 Arbitration

A. All Claims or counterclaims, disputes, or other matters in question between Owner and Contractor arising out of or relating to the Contract Documents or the breach thereof (except for Claims which have been waived by the making or acceptance of final payment as provided by Paragraph 14.09) including but not limited to those not resolved under the provisions of Paragraphs 10.05 or 16.01, will be subject to arbitration in accordance with the rules of Construction Industry Rules of the American Arbitration Association, subject to the conditions and limitations of this Paragraph 16.02. This agreement to arbitrate, and any other agreement or consent to arbitrate entered into, will be specifically enforceable under the prevailing Laws of any court having jurisdiction.

B. The demand for arbitration will be filed in writing with the other party to this Contract and with the selected arbitrator or arbitration provider, and a copy will be sent to Engineer for information. The demand for arbitration will be made within the 30-day period specified in Paragraph 16.01.D, and in all other cases, within a reasonable time after the Claim or counterclaim, dispute, or other matter in question has arisen, and in no event shall any such demand be made after the date when institution of legal or equitable proceedings based on such Claim or other dispute or matter in question would be barred by the applicable statute of limitations.

C. No arbitration arising out of or relating to the Contract Documents shall include by consolidation, joinder, or in any other manner any other individual or entity (including Engineer, and Engineer's consultants and the officers, directors, partners, agents, employees or consultants of any of them) who is not a party to this Contract unless:

1. the inclusion of such other individual or entity is necessary if complete relief is to be afforded among those who are already parties to the arbitration; and

2. such other individual or entity is substantially involved in a question of law or fact which is common to those who are already parties to the arbitration and which will arise in such proceedings.

D. Consolidation shall be by order of the arbitrator(s) in any pending case, or if the arbitrator(s) fail to make an order, a party may apply to a court of competent jurisdiction for such order. The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity shall be specifically enforceable in accordance with the Laws of any court having jurisdiction thereof.

E. The award rendered by the arbitrator(s) shall be consistent with the agreement of the parties, in writing, and include: (i) a concise breakdown of the award; (ii) a written explanation of the award specifically citing the Contract Document provisions deemed applicable and relied on in making the award.

F. The award will be final. Judgment may be entered upon it in any court having jurisdiction thereof, and it will not be subject to modification or appeal, subject to provisions of the controlling Laws relating to vacating or modifying an arbitral award.

G. If the parties decline to arbitrate, such Claims, disputes and other matters shall be decided by a court having jurisdiction.

16.03 General

A. The Contractor will require similar dispute resolution provisions in agreements with its Subcontractors and Suppliers.

B. Contractor shall not have the right to stop performance of the Work pending resolution of a Claim or dispute.

C. Notwithstanding any provision contained in this Article or elsewhere in the Contract Documents, the Owner reserves the following rights in connection with Claims and disputes between the Owner and the Contractor:

1. The right to institute legal action against the Contractor in any court of competent jurisdiction in lieu of demanding arbitration pursuant to this Article, in which case the Claims or disputes which are the subject of such action shall be decided by such court, and not by arbitration.

2. The right to obtain from any court of competent jurisdiction a stay of any arbitration instituted by the Contractor, provided that the application for such stay is made before the appointment of the neutral arbitrator in such arbitration, in which case the Claims or disputes which are the subject of such arbitration shall be decided by such court, and not by arbitration.

3. The right to require the Contractor to join as a party in any arbitration between the Owner and the Engineer relating to the Project, in which case the Contractor agrees to be bound by the decision of the arbitrator or arbitrators in such arbitration.

END OF SECTION

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SECTION 00 73 43

WAGE RATE REQUIREMENTS

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract, EJCDC® C-700 (2007 Edition) included in Section 00 72 05. All provisions that are not so amended or supplemented remain in full force and effect unless amended or supplemented in another Section. The terms used in these Supplementary Conditions have the meanings stated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings stated within the Sections listed below, if any, which are applicable to both the singular and plural thereof.

The content of this Section does not represent or reflect all applicable Laws and Regulations and may only include excerpts and portions of certain Laws and Regulations. Other provisions and policies, and Laws and Regulations, shall be deemed to be so included and incorporated herein. Contractor is solely responsible to determine, obtain, review and interpret the full text of applicable Laws and Regulations.

The Project is subject to prevailing wage rates as issued by the Director of the Executive Office of Labor and Workforce Development (EOLWD), Department of Labor Standards (DLS) and the requirements of MGL Chapter 149, Sections 26, 27 and 27A to 27H. Pursuant to MGL Chapter 149, Section 34B, wages paid to reserve police officers shall be the same prevailing rate of wage paid to regular police officers at the location of the Project. **Wage rates are subject to change annually for the term of the Agreement.**

Comply with requirements available on the Executive Office of Labor and Workforce Development website at https://www.mass.gov/prevailing-wage-program and https://www.mass.gov/service-details/prevailing-wage-for-contractors. See Guide to Contractors at https://www.mass.gov/doc/a-guide-to-prevailing-wage-for-contractors-on-public-works-projects/download.

Submit required records and statements of compliance in accordance with MGL Chapter 149, Section 27B using the latest Weekly Payroll and Compliance forms available on the EOLWD website. Copies included in this section are for information only.

Wage determination schedules are included at the end of this section. In case of discrepancy between state wage rates and Federal wage rates, if any, the higher wage rates shall apply.

ATTACHMENTS

A. Massachusetts Prevailing Wage Law forms (samples)

B. Wage Determination Schedules

END OF SECTION

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WEEKLY PAYROLL RECORDS REPORT
& STATEMENT OF COMPLIANCE

In accordance with Massachusetts General Law c. 149, §27B, a true and accurate record must be kept of all persons employed on the public works project for which the enclosed rates have been provided. A Payroll Form is available from the Department of Labor Standards (DLS) at www.mass.gov/dols/pw and includes all the information required to be kept by law. Every contractor or subcontractor is required to keep these records and preserve them for a period of three years from the date of completion of the contract.

On a weekly basis, every contractor and subcontractor is required to submit a certified copy of their weekly payroll records to the awarding authority; this includes the payroll forms and the Statement of Compliance form. The certified payroll records must be submitted either by regular mail or by e-mail to the awarding authority. Once collected, the awarding authority is required to preserve those records for three years from the date of completion of the project.

Each such contractor and subcontractor shall furnish weekly **and** within 15 days after completion of its portion of the work, to the awarding authority directly by first-class mail or e-mail, a statement, executed by the contractor, subcontractor or by any authorized officer thereof who supervised the payment of wages, this form, accompanied by their payroll:

STATEMENT OF COMPLIANCE

_____, 20_____

I,_____,_____
(Name of signatory party) (Title)

do hereby state:

That I pay or supervise the payment of the persons employed by

_____ on the _____
(Contractor, subcontractor or public body) (Building or project)

and that all mechanics and apprentices, teamsters, chauffeurs and laborers employed on said project have been paid in accordance with wages determined under the provisions of sections twenty-six and twenty-seven of chapter one hundred and forty nine of the General Laws.

Signature _____

Title _____

MASSACHUSETTS WEEKLY CERTIFIED PAYROLL REPORT FORM

Company's Name:	Address:	Phone No.:	Payroll No.:

Employer's Signature:	Title:	Contract No:	Tax Payer ID Number	Work Week Ending:

Awarding Authority's Name:	Public Works Project Name:	Public Works Project Location:	Min. Wage Rate Sheet Number

General / Prime Contractor's Name:	Subcontractor's Name:		"Employer" Hourly Fringe Benefit Contributions

Employee Name & Complete Address	Work Classification:	Employee is OSHA 10 certified (?)	Appr. Rate (%)	Hours Worked Su.	Mo.	Tu.	We.	Th.	Fr.	Sa.	Project Hours (A) All Other Hours	Hourly Base Wage (B)	Health & Welfare Insurance (C)	ERISA Pension Plan (D)	Supp. Unemp. (E)	(B+C+D+E) Total Hourly Prev. Wage (F)	(A x F) Project Gross Wages Total Gross Wages	Check No. (H)

Are all apprentice employees identified above currently registered with the MA DLS's Division of Apprentice Standards? YES ☐ NO ☐

For all apprentices performing work during the reporting period, attach a copy of the apprentice identification card issued by the Massachusetts Department of Labor Standards / Division of Apprentice Standards. No apprentices are identified above ☐

NOTE: Pursuant to MGL c. 149, s. 27B, every contractor and subcontractor is required to submit a **true and accurate** copy of their certified weekly payroll records to the awarding authority by first-class mail or e-mail. In addition, each weekly payroll must be accompanied by a statement of compliance signed by the employer. Failure to comply may result in the commencement of a criminal action or the issuance of a civil citation.

Date Received by Awarding Authority
/ /

MAURA HEALEY
Governor

KIM DRISCOLL
Lt. Governor

THE COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF LABOR AND WORKFORCE DEVELOPMENT
DEPARTMENT OF LABOR STANDARDS

Prevailing Wage Rates

As determined by the Director under the provisions of the Massachusetts General Laws, Chapter 149, Sections 26 to 27H

LAUREN JONES
Secretary

MICHAEL FLANAGAN
Director

Awarding Authority: Town of Tewksbury, MA

Contract Number: 0235334.00 **City/Town:** TEWKSBURY

Description of Work: Demolition, replacement & installation of a backup electrical generator, 2 submersible chopper pumps, pump mounting equipment, instrumentation, control panels, electrical enclosures & concrete slabs.

Job Location: Devonshire Road, Tewksbury, MA 01876

Information about Prevailing Wage Schedules for Awarding Authorities and Contractors

- The wage rates will remain in effect for the duration of the project, except in the case of multi-year public construction projects. For construction projects lasting longer than one year, awarding authorities must request an updated wage schedule no later than two weeks before the anniversary of the date the contract was executed by the awarding authority and the general contractor. For multi-year CM AT RISK projects, the awarding authority must request an annual update no later than two weeks before the anniversary date, determined as the earlier of: (a) the execution date of the GMP Amendment, or (b) the execution date of the first amendment to permit procurement of construction services. The updated wage schedule must be provided to all contractors, including general and sub-contractors, working on the construction project.
- This annual update requirement is generally not applicable to 27F "rental of equipment" contracts. For such contracts, the prevailing wage rates issued by DLS shall remain in effect for the duration of the contract term. However, if the prevailing wage rate sheet issued does not contain wage rates for each year covered by the contract term, the Awarding Authority must request updated rate sheets from DLS and provide them to the contractor to ensure the correct rates are being paid throughout the duration of the contract. Additionally, if an Awarding Authority exercises an option to renew or extend the contract term, they must request updated rate sheets form DLS and provide them to the contractor.
- This wage schedule applies only to the specific project referenced at the top of this page and uniquely identified by the "Wage Request Number" on all pages of this schedule.
- An Awarding Authority must request an updated wage schedule if it has not opened bids or selected a contractor within90 days of the date of issuance of the wage schedule. For CM AT RISK projects (bid pursuant to G.L. c.149A), the earlier of: (a) the execution date of the GMP Amendment, or (b) the bid for the first construction scope of work must be within 90-days of the wage schedule issuance date.
- The wage schedule shall be incorporated in any advertisement or call for bids for the project as required by M.G.L. c. 149, § 27.The wage schedule shall be made a part of the contract awarded for the project. The wage schedule must be posted in a conspicuous place at the work site for the life of the project in accordance with M.G.L. c. 149 § 27. The wages listed on the wage schedule must be paid to employees performing construction work on the project whether they are employed by the prime contractor, a filed sub-bidder, or a sub-contractor.
- Apprentices working on the project are required to be registered with the Massachusetts Division of Apprentice Standards (DAS). Apprentices must keep their apprentice identification card on their persons during all work hours on the project. An apprentice registered with DAS may be paid the lower apprentice wage rate at the applicable step as provided on the prevailing wage schedule. **Any apprentice not registered with DAS regardless of whether they are registered with another federal, state, local, or private agency must be paid the journeyworker's rate.**
- Every contractor or subcontractor working on the construction project must submit weekly payroll reports and a Statement of Compliance directly to the awarding authority by mail or email and keep them on file for three years. Each weekly payroll report must contain: the employee's name, address, occupational classification, hours worked, and wages paid. Do not submit weekly payroll reports to DLS. For a sample payroll reporting form go to http://www.mass.gov/dols/pw.
- Contractors with questions about the wage rates or classifications included on the wage schedule have an affirmative obligation to inquire with DLS at (617) 626-6953.
- Contractors must obtain the wage schedules from awarding authorities. Failure of a contractor or subcontractor to pay the prevailing wage rates listed on the wage schedule to all employees who perform construction work on the project is a violation of the law and subjects the contractor or subcontractor to civil and criminal penalties.
- Employees not receiving the prevailing wage rate set forth on the wage schedule may file a complaint with the Fair Labor Division of the office of the Attorney General at (617) 727-3465.

Issue Date: 01/21/2025 **Wage Request Number:** 20250121-042

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
Construction						
(2 AXLE) DRIVER - EQUIPMENT *TEAMSTERS JOINT COUNCIL NO. 10 ZONE B*	01/01/2025	$39.95	$15.57	$20.17	$0.00	$75.69
	06/01/2025	$40.95	$15.57	$20.17	$0.00	$76.69
	12/01/2025	$40.95	$15.57	$21.78	$0.00	$78.30
	01/01/2026	$40.95	$16.17	$21.78	$0.00	$78.90
	06/01/2026	$41.95	$16.17	$21.78	$0.00	$79.90
	12/01/2026	$41.95	$16.17	$23.52	$0.00	$81.64
	01/01/2027	$41.95	$16.77	$23.52	$0.00	$82.24
(3 AXLE) DRIVER - EQUIPMENT *TEAMSTERS JOINT COUNCIL NO. 10 ZONE B*	01/01/2025	$40.02	$15.57	$20.17	$0.00	$75.76
	06/01/2025	$41.02	$15.57	$20.17	$0.00	$76.76
	12/01/2025	$41.02	$15.57	$21.78	$0.00	$78.37
	01/01/2026	$41.02	$16.17	$21.78	$0.00	$78.97
	06/01/2026	$42.02	$16.17	$21.78	$0.00	$79.97
	12/01/2026	$42.02	$16.17	$23.52	$0.00	$81.71
	01/01/2027	$42.02	$16.77	$23.52	$0.00	$82.31
(4 & 5 AXLE) DRIVER - EQUIPMENT *TEAMSTERS JOINT COUNCIL NO. 10 ZONE B*	01/01/2025	$40.14	$15.57	$20.17	$0.00	$75.88
	06/01/2025	$41.14	$15.57	$20.17	$0.00	$76.88
	12/01/2025	$41.14	$15.57	$21.78	$0.00	$78.49
	01/01/2026	$41.14	$16.17	$21.78	$0.00	$79.09
	06/01/2026	$42.14	$16.17	$21.78	$0.00	$80.09
	12/01/2026	$42.14	$16.17	$23.52	$0.00	$81.83
	01/01/2027	$42.14	$16.77	$23.52	$0.00	$82.43
ADS/SUBMERSIBLE PILOT *PILE DRIVER LOCAL 56 (ZONE 1)*	01/01/2024	$117.16	$10.08	$24.29	$0.00	$151.53
For apprentice rates see "Apprentice- PILE DRIVER"						
AIR TRACK OPERATOR *LABORERS - ZONE 2*	12/01/2024	$40.61	$9.65	$17.70	$0.00	$67.96
	06/01/2025	$42.00	$9.65	$17.70	$0.00	$69.35
	12/01/2025	$43.38	$9.65	$17.70	$0.00	$70.73
	06/01/2026	$44.82	$9.65	$17.70	$0.00	$72.17
	12/01/2026	$46.26	$9.65	$17.70	$0.00	$73.61
	06/01/2027	$47.71	$9.65	$17.70	$0.00	$75.06
	12/01/2027	$49.16	$9.65	$17.70	$0.00	$76.51
	06/01/2028	$50.66	$9.65	$17.70	$0.00	$78.01
	12/01/2028	$52.16	$9.65	$17.70	$0.00	$79.51
For apprentice rates see "Apprentice- LABORER"						
AIR TRACK OPERATOR (HEAVY & HIGHWAY) *LABORERS - ZONE 2 (HEAVY & HIGHWAY)*	12/01/2024	$40.61	$9.65	$17.80	$0.00	$68.06
	06/01/2025	$42.00	$9.65	$17.80	$0.00	$69.45
	12/01/2025	$43.38	$9.65	$17.80	$0.00	$70.83
	06/01/2026	$44.82	$9.65	$17.80	$0.00	$72.27
	12/01/2026	$46.26	$9.65	$17.80	$0.00	$73.71
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
ASBESTOS REMOVER - PIPE / MECH. EQUIPT. *HEAT & FROST INSULATORS LOCAL 6 (BOSTON)*	12/01/2024	$42.80	$14.50	$11.05	$0.00	$68.35
	06/01/2025	$43.80	$14.50	$11.05	$0.00	$69.35
	12/01/2025	$44.80	$14.50	$11.05	$0.00	$70.35

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
ASPHALT RAKER *LABORERS - ZONE 2*	12/01/2024	$40.11	$9.65	$17.70	$0.00	$67.46
	06/01/2025	$41.50	$9.65	$17.70	$0.00	$68.85
	12/01/2025	$42.88	$9.65	$17.70	$0.00	$70.23
	06/01/2026	$44.32	$9.65	$17.70	$0.00	$71.67
	12/01/2026	$45.76	$9.65	$17.70	$0.00	$73.11
	06/01/2027	$47.21	$9.65	$17.70	$0.00	$74.56
	12/01/2027	$48.66	$9.65	$17.70	$0.00	$76.01
	06/01/2028	$50.16	$9.65	$17.70	$0.00	$77.51
	12/01/2028	$51.66	$9.65	$17.70	$0.00	$79.01
For apprentice rates see "Apprentice- LABORER"						
ASPHALT RAKER (HEAVY & HIGHWAY) *LABORERS - ZONE 2 (HEAVY & HIGHWAY)*	12/01/2024	$40.11	$9.65	$17.80	$0.00	$67.56
	06/01/2025	$41.50	$9.65	$17.80	$0.00	$68.95
	12/01/2025	$42.88	$9.65	$17.80	$0.00	$70.33
	06/01/2026	$44.32	$9.65	$17.80	$0.00	$71.77
	12/01/2026	$45.76	$9.65	$17.80	$0.00	$73.21
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
ASPHALT/CONCRETE/CRUSHER PLANT-ON SITE *OPERATING ENGINEERS LOCAL 4*	12/01/2024	$57.03	$15.55	$16.50	$0.00	$89.08
	06/01/2025	$58.33	$15.55	$16.50	$0.00	$90.38
	12/01/2025	$59.78	$15.55	$16.50	$0.00	$91.83
	06/01/2026	$61.08	$15.55	$16.50	$0.00	$93.13
	12/01/2026	$62.53	$15.55	$16.50	$0.00	$94.58
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
BACKHOE/FRONT-END LOADER *OPERATING ENGINEERS LOCAL 4*	12/01/2024	$57.03	$15.55	$16.50	$0.00	$89.08
	06/01/2025	$58.33	$15.55	$16.50	$0.00	$90.38
	12/01/2025	$59.78	$15.55	$16.50	$0.00	$91.83
	06/01/2026	$61.08	$15.55	$16.50	$0.00	$93.13
	12/01/2026	$62.53	$15.55	$16.50	$0.00	$94.58
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
BARCO-TYPE JUMPING TAMPER *LABORERS - ZONE 2*	12/01/2024	$40.11	$9.65	$17.70	$0.00	$67.46
	06/01/2025	$41.50	$9.65	$17.70	$0.00	$68.85
	12/01/2025	$42.88	$9.65	$17.70	$0.00	$70.23
	06/01/2026	$44.32	$9.65	$17.70	$0.00	$71.67
	12/01/2026	$45.76	$9.65	$17.70	$0.00	$73.11
	06/01/2027	$47.21	$9.65	$17.70	$0.00	$74.56
	12/01/2027	$48.66	$9.65	$17.70	$0.00	$76.01
	06/01/2028	$50.16	$9.65	$17.70	$0.00	$77.51
	12/01/2028	$51.66	$9.65	$17.70	$0.00	$79.01
For apprentice rates see "Apprentice- LABORER"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
BLOCK PAVER, RAMMER / CURB SETTER *LABORERS - ZONE 2*	12/01/2024	$40.61	$9.65	$17.70	$0.00	$67.96
	06/01/2025	$42.00	$9.65	$17.70	$0.00	$69.35
	12/01/2025	$43.38	$9.65	$17.70	$0.00	$70.73
	06/01/2026	$44.82	$9.65	$17.70	$0.00	$72.17
	12/01/2026	$46.26	$9.65	$17.70	$0.00	$73.61
	06/01/2027	$47.71	$9.65	$17.70	$0.00	$75.06
	12/01/2027	$49.16	$9.65	$17.70	$0.00	$76.51
	06/01/2028	$50.66	$9.65	$17.70	$0.00	$78.01
	12/01/2028	$52.16	$9.65	$17.70	$0.00	$79.51
For apprentice rates see "Apprentice- LABORER"						
BLOCK PAVER, RAMMER / CURB SETTER (HEAVY & HIGHWAY) *LABORERS - ZONE 2 (HEAVY & HIGHWAY)*	12/01/2024	$40.61	$9.65	$17.80	$0.00	$68.06
	06/01/2025	$42.00	$9.65	$17.80	$0.00	$69.45
	12/01/2025	$43.38	$9.65	$17.80	$0.00	$70.83
	06/01/2026	$44.82	$9.65	$17.80	$0.00	$72.27
	12/01/2026	$46.26	$9.65	$17.80	$0.00	$73.71
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
BOILER MAKER *BOILERMAKERS LOCAL 29*	01/01/2024	$48.12	$7.07	$20.60	$0.00	$75.79

Apprentice - *BOILERMAKER - Local 29*

Effective Date - 01/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	65	$31.28	$7.07	$13.22	$0.00	$51.57
2	65	$31.28	$7.07	$13.22	$0.00	$51.57
3	70	$33.68	$7.07	$14.23	$0.00	$54.98
4	75	$36.09	$7.07	$15.24	$0.00	$58.40
5	80	$38.50	$7.07	$16.25	$0.00	$61.82
6	85	$40.90	$7.07	$17.28	$0.00	$65.25
7	90	$43.31	$7.07	$18.28	$0.00	$68.66
8	95	$45.71	$7.07	$19.32	$0.00	$72.10

Notes:

Apprentice to Journeyworker Ratio:1:4

BRICK/STONE/ARTIFICIAL MASONRY (INCL. MASONRY WATERPROOFING) *BRICKLAYERS LOCAL 3 (LOWELL)*	08/01/2024	$62.36	$11.49	$22.90	$0.00	$96.75
	02/01/2025	$63.66	$11.49	$22.90	$0.00	$98.05
	08/01/2025	$65.81	$11.49	$22.90	$0.00	$100.20
	02/01/2026	$67.16	$11.49	$22.90	$0.00	$101.55
	08/01/2026	$69.36	$11.49	$22.90	$0.00	$103.75
	02/01/2027	$70.76	$11.49	$22.90	$0.00	$105.15

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *BRICK/PLASTER/CEMENT MASON - Local 3 Lowell*

Effective Date - 08/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$31.18	$11.49	$22.90	$0.00	$65.57
2	60	$37.42	$11.49	$22.90	$0.00	$71.81
3	70	$43.65	$11.49	$22.90	$0.00	$78.04
4	80	$49.89	$11.49	$22.90	$0.00	$84.28
5	90	$56.12	$11.49	$22.90	$0.00	$90.51

Effective Date - 02/01/2025

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$31.83	$11.49	$22.90	$0.00	$66.22
2	60	$38.20	$11.49	$22.90	$0.00	$72.59
3	70	$44.56	$11.49	$22.90	$0.00	$78.95
4	80	$50.93	$11.49	$22.90	$0.00	$85.32
5	90	$57.29	$11.49	$22.90	$0.00	$91.68

Notes:

Apprentice to Journeyworker Ratio:1:5

BULLDOZER/GRADER/SCRAPER *OPERATING ENGINEERS LOCAL 4*	12/01/2024	$56.40	$15.55	$16.50	$0.00	$88.45
	06/01/2025	$57.68	$15.55	$16.50	$0.00	$89.73
	12/01/2025	$59.12	$15.55	$16.50	$0.00	$91.17
	06/01/2026	$60.40	$15.55	$16.50	$0.00	$92.45
	12/01/2026	$61.84	$15.55	$16.50	$0.00	$93.89
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
CAISSON & UNDERPINNING BOTTOM MAN *LABORERS - FOUNDATION AND MARINE*	12/01/2024	$48.10	$9.65	$18.22	$0.00	$75.97
	06/01/2025	$49.60	$9.65	$18.22	$0.00	$77.47
	12/01/2025	$51.10	$9.65	$18.22	$0.00	$78.97
	06/01/2026	$52.65	$9.65	$18.22	$0.00	$80.52
	12/01/2026	$54.15	$9.65	$18.22	$0.00	$82.02
For apprentice rates see "Apprentice- LABORER"						
CAISSON & UNDERPINNING LABORER *LABORERS - FOUNDATION AND MARINE*	12/01/2024	$46.95	$9.65	$18.22	$0.00	$74.82
	06/01/2025	$48.45	$9.65	$18.22	$0.00	$76.32
	12/01/2025	$49.95	$9.65	$18.22	$0.00	$77.82
	06/01/2026	$51.50	$9.65	$18.22	$0.00	$79.37
	12/01/2026	$53.00	$9.65	$18.22	$0.00	$80.87
For apprentice rates see "Apprentice- LABORER"						
CAISSON & UNDERPINNING TOP MAN *LABORERS - FOUNDATION AND MARINE*	12/01/2024	$47.28	$9.65	$18.22	$0.00	$75.15
	06/01/2025	$48.78	$9.65	$18.22	$0.00	$76.65
	12/01/2025	$50.28	$9.65	$18.22	$0.00	$78.15
	06/01/2026	$51.83	$9.65	$18.22	$0.00	$79.70
	12/01/2026	$53.33	$9.65	$18.22	$0.00	$81.20
For apprentice rates see "Apprentice- LABORER"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
CARBIDE CORE DRILL OPERATOR	12/01/2024	$40.11	$9.65	$17.70	$0.00	$67.46
LABORERS - ZONE 2	06/01/2025	$41.50	$9.65	$17.70	$0.00	$68.85
	12/01/2025	$42.88	$9.65	$17.70	$0.00	$70.23
	06/01/2026	$44.32	$9.65	$17.70	$0.00	$71.67
	12/01/2026	$45.76	$9.65	$17.70	$0.00	$73.11
	06/01/2027	$47.21	$9.65	$17.70	$0.00	$74.56
	12/01/2027	$48.66	$9.65	$17.70	$0.00	$76.01
	06/01/2028	$50.16	$9.65	$17.70	$0.00	$77.51
	12/01/2028	$51.66	$9.65	$17.70	$0.00	$79.01
For apprentice rates see "Apprentice- LABORER"						
CARPENTER	09/01/2024	$48.37	$9.83	$19.97	$0.00	$78.17
CARPENTERS -ZONE 2 (Eastern Massachusetts)	03/01/2025	$49.62	$9.83	$19.97	$0.00	$79.42
	09/01/2025	$50.87	$9.83	$19.97	$0.00	$80.67
	03/01/2026	$52.12	$9.83	$19.97	$0.00	$81.92
	09/01/2026	$53.37	$9.83	$19.97	$0.00	$83.17
	03/01/2027	$54.62	$9.83	$19.97	$0.00	$84.42

Apprentice - *CARPENTER - Zone 2 Eastern MA*

Effective Date - 09/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	45	$21.77	$9.83	$1.73	$0.00	$33.33
2	45	$21.77	$9.83	$1.73	$0.00	$33.33
3	55	$26.60	$9.83	$3.40	$0.00	$39.83
4	55	$26.60	$9.83	$3.40	$0.00	$39.83
5	70	$33.86	$9.83	$16.51	$0.00	$60.20
6	70	$33.86	$9.83	$16.51	$0.00	$60.20
7	80	$38.70	$9.83	$18.24	$0.00	$66.77
8	80	$38.70	$9.83	$18.24	$0.00	$66.77

Effective Date - 03/01/2025

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	45	$22.33	$9.83	$1.73	$0.00	$33.89
2	45	$22.33	$9.83	$1.73	$0.00	$33.89
3	55	$27.29	$9.83	$3.40	$0.00	$40.52
4	55	$27.29	$9.83	$3.40	$0.00	$40.52
5	70	$34.73	$9.83	$16.51	$0.00	$61.07
6	70	$34.73	$9.83	$16.51	$0.00	$61.07
7	80	$39.70	$9.83	$18.24	$0.00	$67.77
8	80	$39.70	$9.83	$18.24	$0.00	$67.77

Notes:

Apprentice to Journeyworker Ratio:1:5

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
CARPENTER WOOD FRAME *CARPENTERS-ZONE 3 (Wood Frame)*	10/01/2024	$26.65	$7.02	$4.80	$0.00	$38.47
	10/01/2025	$27.75	$7.02	$4.80	$0.00	$39.57
	10/01/2026	$28.85	$7.02	$4.80	$0.00	$40.67

All Aspects of New Wood Frame Work

Apprentice - *CARPENTER (Wood Frame) - Zone 3*

Effective Date - 10/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	$15.99	$7.02	$0.00	$0.00	$23.01
2	60	$15.99	$7.02	$0.00	$0.00	$23.01
3	65	$17.32	$7.02	$1.00	$0.00	$25.34
4	70	$18.66	$7.02	$1.00	$0.00	$26.68
5	75	$19.99	$7.02	$4.80	$0.00	$31.81
6	80	$21.32	$7.02	$4.80	$0.00	$33.14
7	85	$22.65	$7.02	$4.80	$0.00	$34.47
8	90	$23.99	$7.02	$4.80	$0.00	$35.81

Effective Date - 10/01/2025

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	$16.65	$7.02	$0.00	$0.00	$23.67
2	60	$16.65	$7.02	$0.00	$0.00	$23.67
3	65	$18.04	$7.02	$1.00	$0.00	$26.06
4	70	$19.43	$7.02	$1.00	$0.00	$27.45
5	75	$20.81	$7.02	$4.80	$0.00	$32.63
6	80	$22.20	$7.02	$4.80	$0.00	$34.02
7	85	$23.59	$7.02	$4.80	$0.00	$35.41
8	90	$24.98	$7.02	$4.80	$0.00	$36.80

Notes:

Apprentice to Journeyworker Ratio:1:5

CEMENT MASONRY/PLASTERING *BRICKLAYERS LOCAL 3 (LOWELL)*	07/01/2024	$49.19	$13.35	$24.21	$1.80	$88.55

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *CEMENT MASONRY/PLASTERING - Lowell*

Effective Date - 07/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$24.60	$13.35	$16.43	$0.00	$54.38
2	60	$29.51	$13.35	$19.21	$1.80	$63.87
3	65	$31.97	$13.35	$20.21	$1.80	$67.33
4	70	$34.43	$13.35	$21.21	$1.80	$70.79
5	75	$36.89	$13.35	$22.21	$1.80	$74.25
6	80	$39.35	$13.35	$23.21	$1.80	$77.71
7	90	$44.27	$13.35	$24.21	$1.80	$83.63

Notes:

Steps 3,4 are 500 hrs. All other steps are 1,000 hrs.

Apprentice to Journeyworker Ratio:1:3

CHAIN SAW OPERATOR *LABORERS - ZONE 2*	12/01/2024	$40.11	$9.65	$17.70	$0.00	$67.46
	06/01/2025	$41.50	$9.65	$17.70	$0.00	$68.85
	12/01/2025	$42.88	$9.65	$17.70	$0.00	$70.23
	06/01/2026	$44.32	$9.65	$17.70	$0.00	$71.67
	12/01/2026	$45.76	$9.65	$17.70	$0.00	$73.11
	06/01/2027	$47.21	$9.65	$17.70	$0.00	$74.56
	12/01/2027	$48.66	$9.65	$17.70	$0.00	$76.01
	06/01/2028	$50.16	$9.65	$17.70	$0.00	$77.51
	12/01/2028	$51.66	$9.65	$17.70	$0.00	$79.01
For apprentice rates see "Apprentice- LABORER"						
CLAM SHELLS/SLURRY BUCKETS/HEADING MACHINES *OPERATING ENGINEERS LOCAL 4*	12/01/2024	$58.18	$15.55	$16.50	$0.00	$90.23
	06/01/2025	$59.51	$15.55	$16.50	$0.00	$91.56
	12/01/2025	$60.98	$15.55	$16.50	$0.00	$93.03
	06/01/2026	$62.31	$15.55	$16.50	$0.00	$94.36
	12/01/2026	$63.79	$15.55	$16.50	$0.00	$95.84
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
COMPRESSOR OPERATOR *OPERATING ENGINEERS LOCAL 4*	12/01/2024	$36.67	$15.55	$16.50	$0.00	$68.72
	06/01/2025	$37.52	$15.55	$16.50	$0.00	$69.57
	12/01/2025	$38.47	$15.55	$16.50	$0.00	$70.52
	06/01/2026	$39.33	$15.55	$16.50	$0.00	$71.38
	12/01/2026	$40.28	$15.55	$16.50	$0.00	$72.33
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
DELEADER (BRIDGE) *PAINTERS LOCAL 35 - ZONE 2*	01/01/2025	$58.46	$9.95	$23.95	$0.00	$92.36

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *PAINTER Local 35 - BRIDGES/TANKS*

Effective Date - 01/01/2025

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$29.23	$9.95	$0.00	$0.00	$39.18
2	55	$32.15	$9.95	$6.66	$0.00	$48.76
3	60	$35.08	$9.95	$7.26	$0.00	$52.29
4	65	$38.00	$9.95	$7.87	$0.00	$55.82
5	70	$40.92	$9.95	$20.32	$0.00	$71.19
6	75	$43.85	$9.95	$20.93	$0.00	$74.73
7	80	$46.77	$9.95	$21.53	$0.00	$78.25
8	90	$52.61	$9.95	$22.74	$0.00	$85.30

Notes:
Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

DEMO: ADZEMAN *LABORERS - ZONE 2*	12/02/2024	$47.00	$9.65	$18.40	$0.00	$75.05
	06/02/2025	$48.50	$9.65	$18.40	$0.00	$76.55
	12/01/2025	$50.00	$9.65	$18.40	$0.00	$78.05
	06/01/2026	$51.55	$9.65	$18.40	$0.00	$79.60
	12/07/2026	$53.05	$9.65	$18.40	$0.00	$81.10
	06/07/2027	$54.65	$9.65	$18.40	$0.00	$82.70
	12/06/2027	$56.25	$9.65	$18.40	$0.00	$84.30
	06/05/2028	$57.93	$9.65	$18.40	$0.00	$85.98
	12/04/2028	$59.60	$9.65	$18.40	$0.00	$87.65
For apprentice rates see "Apprentice- LABORER"						
DEMO: BACKHOE/LOADER/HAMMER OPERATOR *LABORERS - ZONE 2*	12/02/2024	$48.00	$9.65	$18.40	$0.00	$76.05
	06/02/2025	$49.50	$9.65	$18.40	$0.00	$77.55
	12/01/2025	$51.00	$9.65	$18.40	$0.00	$79.05
	06/01/2026	$52.55	$9.65	$18.40	$0.00	$80.60
	12/07/2026	$54.05	$9.65	$18.40	$0.00	$82.10
	06/07/2027	$55.65	$9.65	$18.40	$0.00	$83.70
	12/06/2027	$57.25	$9.65	$18.40	$0.00	$85.30
	06/05/2028	$58.93	$9.65	$18.40	$0.00	$86.98
	12/04/2028	$60.60	$9.65	$18.40	$0.00	$88.65
For apprentice rates see "Apprentice- LABORER"						
DEMO: BURNERS *LABORERS - ZONE 2*	12/02/2024	$47.75	$9.65	$18.40	$0.00	$75.80
	06/02/2025	$49.25	$9.65	$18.40	$0.00	$77.30
	12/01/2025	$50.75	$9.65	$18.40	$0.00	$78.80
	06/01/2026	$52.30	$9.65	$18.40	$0.00	$80.35
	12/07/2026	$53.80	$9.65	$18.40	$0.00	$81.85
	06/07/2027	$55.40	$9.65	$18.40	$0.00	$83.45
	12/06/2027	$57.00	$9.65	$18.40	$0.00	$85.05
	06/05/2028	$58.68	$9.65	$18.40	$0.00	$86.73
	12/04/2028	$60.35	$9.65	$18.40	$0.00	$88.40

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
For apprentice rates see "Apprentice- LABORER"						
DEMO: CONCRETE CUTTER/SAWYER *LABORERS - ZONE 2*	12/02/2024	$48.00	$9.65	$18.40	$0.00	$76.05
	06/02/2025	$49.50	$9.65	$18.40	$0.00	$77.55
	12/01/2025	$51.00	$9.65	$18.40	$0.00	$79.05
	06/01/2026	$52.55	$9.65	$18.40	$0.00	$80.60
	12/07/2026	$54.05	$9.65	$18.40	$0.00	$82.10
	06/07/2027	$55.65	$9.65	$18.40	$0.00	$83.70
	12/06/2027	$57.25	$9.65	$18.40	$0.00	$85.30
	06/05/2028	$58.93	$9.65	$18.40	$0.00	$86.98
	12/04/2028	$60.60	$9.65	$18.40	$0.00	$88.65
For apprentice rates see "Apprentice- LABORER"						
DEMO: JACKHAMMER OPERATOR *LABORERS - ZONE 2*	12/02/2024	$47.75	$9.65	$18.40	$0.00	$75.80
	06/02/2025	$49.25	$9.65	$18.40	$0.00	$77.30
	12/01/2025	$50.75	$9.65	$18.40	$0.00	$78.80
	06/01/2026	$52.30	$9.65	$18.40	$0.00	$80.35
	12/07/2026	$53.80	$9.65	$18.40	$0.00	$81.85
	06/07/2027	$55.40	$9.65	$18.40	$0.00	$83.45
	12/06/2027	$57.00	$9.65	$18.40	$0.00	$85.05
	06/05/2028	$58.68	$9.65	$18.40	$0.00	$86.73
	12/04/2028	$60.35	$9.65	$18.40	$0.00	$88.40
For apprentice rates see "Apprentice- LABORER"						
DEMO: WRECKING LABORER *LABORERS - ZONE 2*	12/02/2024	$47.00	$9.65	$18.40	$0.00	$75.05
	06/02/2025	$48.50	$9.65	$18.40	$0.00	$76.55
	12/01/2025	$50.00	$9.65	$18.40	$0.00	$78.05
	06/01/2026	$51.55	$9.65	$18.40	$0.00	$79.60
	12/07/2026	$53.05	$9.65	$18.40	$0.00	$81.10
	06/07/2027	$54.65	$9.65	$18.40	$0.00	$82.70
	12/06/2027	$56.25	$9.65	$18.40	$0.00	$84.30
	06/05/2028	$57.93	$9.65	$18.40	$0.00	$85.98
	12/04/2028	$59.60	$9.65	$18.40	$0.00	$87.65
For apprentice rates see "Apprentice- LABORER"						
DIRECTIONAL DRILL MACHINE OPERATOR *OPERATING ENGINEERS LOCAL 4*	12/01/2024	$56.40	$15.55	$16.50	$0.00	$88.45
	06/01/2025	$57.68	$15.55	$16.50	$0.00	$89.73
	12/01/2025	$59.12	$15.55	$16.50	$0.00	$91.17
	06/01/2026	$60.40	$15.55	$16.50	$0.00	$92.45
	12/01/2026	$61.84	$15.55	$16.50	$0.00	$93.89
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
DIVER *PILE DRIVER LOCAL 56 (ZONE 1)*	08/01/2024	$78.11	$10.08	$21.66	$0.00	$109.85
as of 8-1-24, Apprentices with diving licenses begin at second year. % of Diver wage 70/80/90 2A $69.83, 3A $91.79,4A $102.14 Total Rate						
DIVER TENDER *PILE DRIVER LOCAL 56 (ZONE 1)*	08/01/2024	$55.79	$10.08	$24.29	$0.00	$90.16
as of 8-1-24, Apprentices with diving licenses begin at second year. % of Piledriver wage 70/80/90 2A $54.20, 3A $73.93,4A $82.05 Total Rate						
DIVER TENDER (EFFLUENT) *PILE DRIVER LOCAL 56 (ZONE 1)*	08/01/2024	$83.69	$10.08	$24.29	$0.00	$118.06
For apprentice rates see "Apprentice- PILE DRIVER"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
DIVER/SLURRY (EFFLUENT) *PILE DRIVER LOCAL 56 (ZONE 1)* For apprentice rates see "Apprentice- PILE DRIVER"	08/01/2024	$117.16	$10.08	$24.29	$0.00	$151.53
DRAWBRIDGE OPERATOR (Construction) *DRAWBRIDGE - SEIU LOCAL 888*	07/01/2020	$26.77	$6.67	$3.93	$0.16	$37.53
ELECTRICIAN *ELECTRICIANS LOCAL 103*	09/01/2024	$63.78	$13.00	$22.26	$0.00	$99.04
	03/01/2025	$64.98	$13.00	$22.30	$0.00	$100.28
	09/01/2025	$66.89	$13.00	$22.36	$0.00	$102.25
	03/01/2026	$68.09	$13.00	$22.39	$0.00	$103.48
	09/01/2026	$70.00	$13.00	$22.45	$0.00	$105.45
	03/01/2027	$71.19	$13.00	$22.49	$0.00	$106.68
	09/01/2027	$73.11	$13.00	$22.54	$0.00	$108.65
	03/01/2028	$74.31	$13.00	$22.58	$0.00	$109.89

Apprentice - *ELECTRICIAN - Local 103*

Effective Date - 09/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	$25.51	$13.00	$0.77	$0.00	$39.28
2	40	$25.51	$13.00	$0.77	$0.00	$39.28
3	45	$28.70	$13.00	$16.69	$0.00	$58.39
4	45	$28.70	$13.00	$16.69	$0.00	$58.39
5	50	$31.89	$13.00	$17.20	$0.00	$62.09
6	55	$35.08	$13.00	$17.70	$0.00	$65.78
7	60	$38.27	$13.00	$18.21	$0.00	$69.48
8	65	$41.46	$13.00	$18.71	$0.00	$73.17
9	70	$44.65	$13.00	$19.22	$0.00	$76.87
10	75	$47.84	$13.00	$19.74	$0.00	$80.58

Effective Date - 03/01/2025

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	$25.99	$13.00	$0.78	$0.00	$39.77
2	40	$25.99	$13.00	$0.78	$0.00	$39.77
3	45	$29.24	$13.00	$16.71	$0.00	$58.95
4	45	$29.24	$13.00	$16.71	$0.00	$58.95
5	50	$32.49	$13.00	$17.21	$0.00	$62.70
6	55	$35.74	$13.00	$17.72	$0.00	$66.46
7	60	$38.99	$13.00	$18.23	$0.00	$70.22
8	65	$42.24	$13.00	$18.74	$0.00	$73.98
9	70	$45.49	$13.00	$19.24	$0.00	$77.73
10	75	$48.74	$13.00	$19.76	$0.00	$81.50

Notes: :

Apprentice to Journeyworker Ratio:2:3***

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
ELEVATOR CONSTRUCTOR *ELEVATOR CONSTRUCTORS LOCAL 4*	01/01/2022	$65.62	$16.03	$20.21	$0.00	$101.86

Apprentice - *ELEVATOR CONSTRUCTOR - Local 4*

Effective Date - 01/01/2022

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$32.81	$16.03	$0.00	$0.00	$48.84
2	55	$36.09	$16.03	$20.21	$0.00	$72.33
3	65	$42.65	$16.03	$20.21	$0.00	$78.89
4	70	$45.93	$16.03	$20.21	$0.00	$82.17
5	80	$52.50	$16.03	$20.21	$0.00	$88.74

Notes:

Steps 1-2 are 6 mos.; Steps 3-5 are 1 year

Apprentice to Journeyworker Ratio:1:1

ELEVATOR CONSTRUCTOR HELPER *ELEVATOR CONSTRUCTORS LOCAL 4*	01/01/2022	$45.93	$16.03	$20.21	$0.00	$82.17
For apprentice rates see "Apprentice - ELEVATOR CONSTRUCTOR"						
FENCE & GUARD RAIL ERECTOR (HEAVY & HIGHWAY) *LABORERS - ZONE 2 (HEAVY & HIGHWAY)*	12/01/2024	$40.11	$9.65	$17.80	$0.00	$67.56
	06/01/2025	$41.50	$9.65	$17.80	$0.00	$68.95
	12/01/2025	$42.88	$9.65	$17.80	$0.00	$70.33
	06/01/2026	$44.32	$9.65	$17.80	$0.00	$71.77
	12/01/2026	$45.76	$9.65	$17.80	$0.00	$73.21
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
FIELD ENG.INST.PERSON-BLDG,SITE,HVY/HWY *OPERATING ENGINEERS LOCAL 4*	11/01/2024	$51.78	$15.30	$16.40	$0.00	$83.48
	05/01/2025	$53.22	$15.30	$16.40	$0.00	$84.92
	11/01/2025	$54.51	$15.30	$16.40	$0.00	$86.21
	05/01/2026	$55.95	$15.30	$16.40	$0.00	$87.65
	11/01/2026	$57.24	$15.30	$16.40	$0.00	$88.94
	05/01/2027	$58.67	$15.30	$16.40	$0.00	$90.37
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
FIELD ENG.PARTY CHIEF-BLDG,SITE,HVY/HWY *OPERATING ENGINEERS LOCAL 4*	11/01/2024	$53.37	$15.30	$16.40	$0.00	$85.07
	05/01/2025	$54.82	$15.30	$16.40	$0.00	$86.52
	11/01/2025	$56.12	$15.30	$16.40	$0.00	$87.82
	05/01/2026	$57.57	$15.30	$16.40	$0.00	$89.27
	11/01/2026	$58.87	$15.30	$16.40	$0.00	$90.57
	05/01/2027	$60.32	$15.30	$16.40	$0.00	$92.02
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
FIELD ENG.ROD PERSON-BLDG,SITE,HVY/HWY *OPERATING ENGINEERS LOCAL 4*	11/01/2024	$25.37	$15.30	$16.40	$0.00	$57.07
	05/01/2025	$26.22	$15.30	$16.40	$0.00	$57.92
	11/01/2025	$26.98	$15.30	$16.40	$0.00	$58.68
	05/01/2026	$27.83	$15.30	$16.40	$0.00	$59.53
	11/01/2026	$28.59	$15.30	$16.40	$0.00	$60.29
	05/01/2027	$29.44	$15.30	$16.40	$0.00	$61.14
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
FIRE ALARM INSTALLER *ELECTRICIANS LOCAL 103*	09/01/2024	$63.78	$13.00	$22.26	$0.00	$99.04
	03/01/2025	$64.98	$13.00	$22.30	$0.00	$100.28
	09/01/2025	$66.89	$13.00	$22.36	$0.00	$102.25
	03/01/2026	$68.09	$13.00	$22.39	$0.00	$103.48
	09/01/2026	$70.00	$13.00	$22.45	$0.00	$105.45
	03/01/2027	$71.19	$13.00	$22.49	$0.00	$106.68
	09/01/2027	$73.11	$13.00	$22.54	$0.00	$108.65
	03/01/2028	$74.31	$13.00	$22.58	$0.00	$109.89
For apprentice rates see "Apprentice- ELECTRICIAN"						
FIRE ALARM REPAIR / MAINTENANCE / COMMISSIONING*ELECTRICIANS LOCAL 103*	09/01/2024	$51.02	$13.00	$20.24	$0.00	$84.26
	03/01/2025	$51.98	$13.00	$20.27	$0.00	$85.25
	09/01/2025	$53.51	$13.00	$20.32	$0.00	$86.83
	03/01/2026	$54.47	$13.00	$20.34	$0.00	$87.81
	09/01/2026	$56.00	$13.00	$20.39	$0.00	$89.39
	03/01/2027	$56.95	$13.00	$20.42	$0.00	$90.37
	09/01/2027	$58.49	$13.00	$20.46	$0.00	$91.95
	03/01/2028	$59.45	$13.00	$20.49	$0.00	$92.94
For apprentice rates see "Apprentice- TELECOMMUNICATIONS TECHNICIAN"						
FIREMAN (ASST. ENGINEER) *OPERATING ENGINEERS LOCAL 4*	12/01/2024	$45.96	$15.55	$16.50	$0.00	$78.01
	06/01/2025	$47.02	$15.55	$16.50	$0.00	$79.07
	12/01/2025	$48.19	$15.55	$16.50	$0.00	$80.24
	06/01/2026	$49.25	$15.55	$16.50	$0.00	$81.30
	12/01/2026	$50.43	$15.55	$16.50	$0.00	$82.48
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
FLAGGER & SIGNALER (HEAVY & HIGHWAY) *LABORERS - ZONE 2 (HEAVY & HIGHWAY)*	12/01/2024	$27.01	$9.65	$17.80	$0.00	$54.46
	06/01/2025	$28.09	$9.65	$17.80	$0.00	$55.54
	12/01/2025	$28.09	$9.65	$17.80	$0.00	$55.54
	06/01/2026	$29.21	$9.65	$17.80	$0.00	$56.66
	12/01/2026	$29.21	$9.65	$17.80	$0.00	$56.66
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
FLOORCOVERER *FLOORCOVERERS LOCAL 2168 ZONE I*	09/01/2024	$56.23	$8.83	$20.27	$0.00	$85.33
	03/01/2025	$57.73	$8.83	$20.27	$0.00	$86.83
	09/01/2025	$59.23	$8.83	$20.27	$0.00	$88.33
	03/01/2026	$60.73	$8.83	$20.27	$0.00	$89.83
	09/01/2026	$62.23	$8.83	$20.27	$0.00	$91.33
	03/01/2027	$63.73	$8.83	$20.27	$0.00	$92.83

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *FLOORCOVERER - Local 2168 Zone I*

Effective Date - 09/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	45	$25.30	$8.83	$1.76	$0.00	$35.89
2	45	$25.30	$8.83	$1.76	$0.00	$35.89
3	55	$30.93	$8.83	$3.52	$0.00	$43.28
4	55	$30.93	$8.83	$3.52	$0.00	$43.28
5	70	$39.36	$8.83	$16.75	$0.00	$64.94
6	70	$39.36	$8.83	$16.75	$0.00	$64.94
7	80	$44.98	$8.83	$18.51	$0.00	$72.32
8	80	$44.98	$8.83	$18.51	$0.00	$72.32

Effective Date - 03/01/2025

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	45	$25.98	$8.83	$1.76	$0.00	$36.57
2	45	$25.98	$8.83	$1.76	$0.00	$36.57
3	55	$31.75	$8.83	$3.52	$0.00	$44.10
4	55	$31.75	$8.83	$3.52	$0.00	$44.10
5	70	$40.41	$8.83	$16.75	$0.00	$65.99
6	70	$40.41	$8.83	$16.75	$0.00	$65.99
7	80	$46.18	$8.83	$18.51	$0.00	$73.52
8	80	$46.18	$8.83	$18.51	$0.00	$73.52

Notes: Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

FORK LIFT/CHERRY PICKER *OPERATING ENGINEERS LOCAL 4*	12/01/2024	$57.03	$15.55	$16.50	$0.00	$89.08
	06/01/2025	$58.33	$15.55	$16.50	$0.00	$90.38
	12/01/2025	$59.78	$15.55	$16.50	$0.00	$91.83
	06/01/2026	$61.08	$15.55	$16.50	$0.00	$93.13
	12/01/2026	$62.53	$15.55	$16.50	$0.00	$94.58
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
GENERATOR/LIGHTING PLANT/HEATERS *OPERATING ENGINEERS LOCAL 4*	12/01/2024	$36.67	$15.55	$16.50	$0.00	$68.72
	06/01/2025	$37.52	$15.55	$16.50	$0.00	$69.57
	12/01/2025	$38.47	$15.55	$16.50	$0.00	$70.52
	06/01/2026	$39.33	$15.55	$16.50	$0.00	$71.38
	12/01/2026	$40.28	$15.55	$16.50	$0.00	$72.33
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
GLAZIER (GLASS PLANK/AIR BARRIER/INTERIOR SYSTEMS) *GLAZIERS LOCAL 35 (ZONE 2)*	01/01/2025	$47.96	$9.95	$23.95	$0.00	$81.86

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *GLAZIER - Local 35 Zone 2*

Effective Date - 01/01/2025

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$23.98	$9.95	$0.00	$0.00	$33.93
2	55	$26.38	$9.95	$6.66	$0.00	$42.99
3	60	$28.78	$9.95	$7.26	$0.00	$45.99
4	65	$31.17	$9.95	$7.87	$0.00	$48.99
5	70	$33.57	$9.95	$20.32	$0.00	$63.84
6	75	$35.97	$9.95	$20.93	$0.00	$66.85
7	80	$38.37	$9.95	$21.53	$0.00	$69.85
8	90	$43.16	$9.95	$22.74	$0.00	$75.85

Notes:

Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

HOISTING ENGINEER/CRANES/GRADALLS *OPERATING ENGINEERS LOCAL 4*	12/01/2024	$57.03	$15.55	$16.50	$0.00	$89.08
	06/01/2025	$58.33	$15.55	$16.50	$0.00	$90.38
	12/01/2025	$59.78	$15.55	$16.50	$0.00	$91.83
	06/01/2026	$61.08	$15.55	$16.50	$0.00	$93.13
	12/01/2026	$62.53	$15.55	$16.50	$0.00	$94.58

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *OPERATING ENGINEERS - Local 4*

Effective Date - 12/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	55	$31.37	$0.00	$0.00	$0.00	$31.37
2	60	$34.22	$15.55	$16.50	$0.00	$66.27
3	65	$37.07	$15.55	$16.50	$0.00	$69.12
4	70	$39.92	$15.55	$16.50	$0.00	$71.97
5	75	$42.77	$15.55	$16.50	$0.00	$74.82
6	80	$45.62	$15.55	$16.50	$0.00	$77.67
7	85	$48.48	$15.55	$16.50	$0.00	$80.53
8	90	$51.33	$15.55	$16.50	$0.00	$83.38

Effective Date - 06/01/2025

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	55	$32.08	$0.00	$0.00	$0.00	$32.08
2	60	$35.00	$15.55	$16.50	$0.00	$67.05
3	65	$37.91	$15.55	$16.50	$0.00	$69.96
4	70	$40.83	$15.55	$16.50	$0.00	$72.88
5	75	$43.75	$15.55	$16.50	$0.00	$75.80
6	80	$46.66	$15.55	$16.50	$0.00	$78.71
7	85	$49.58	$15.55	$16.50	$0.00	$81.63
8	90	$52.50	$15.55	$16.50	$0.00	$84.55

Notes:

Apprentice to Journeyworker Ratio:1:6

HVAC (DUCTWORK) *SHEETMETAL WORKERS LOCAL 17 - A*	08/01/2024	$57.94	$14.75	$28.12	$2.98	$103.79
	02/01/2025	$59.69	$14.75	$28.12	$2.98	$105.54
	08/01/2025	$61.54	$14.75	$28.12	$2.98	$107.39
	02/01/2026	$63.49	$14.75	$28.12	$2.98	$109.34
For apprentice rates see "Apprentice- SHEET METAL WORKER"						
HVAC (ELECTRICAL CONTROLS) *ELECTRICIANS LOCAL 103*	09/01/2024	$63.78	$13.00	$22.26	$0.00	$99.04
	03/01/2025	$64.98	$13.00	$22.30	$0.00	$100.28
	09/01/2025	$66.89	$13.00	$22.36	$0.00	$102.25
	03/01/2026	$68.09	$13.00	$22.39	$0.00	$103.48
	09/01/2026	$70.00	$13.00	$22.45	$0.00	$105.45
	03/01/2027	$71.19	$13.00	$22.49	$0.00	$106.68
	09/01/2027	$73.11	$13.00	$22.54	$0.00	$108.65
	03/01/2028	$74.31	$13.00	$22.58	$0.00	$109.89
For apprentice rates see "Apprentice- ELECTRICIAN"						
HVAC (TESTING AND BALANCING - AIR) *SHEETMETAL WORKERS LOCAL 17 - A*	08/01/2024	$57.94	$14.75	$28.12	$2.98	$103.79
	02/01/2025	$59.69	$14.75	$28.12	$2.98	$105.54
	08/01/2025	$61.54	$14.75	$28.12	$2.98	$107.39
	02/01/2026	$63.49	$14.75	$28.12	$2.98	$109.34

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
For apprentice rates see "Apprentice- SHEET METAL WORKER"						
HVAC (TESTING AND BALANCING -WATER) *PIPEFITTERS LOCAL 537*	09/01/2024	$67.08	$12.70	$21.80	$0.00	$101.58
	03/01/2025	$68.88	$12.70	$21.80	$0.00	$103.38
For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER"						
HVAC MECHANIC *PIPEFITTERS LOCAL 537*	09/01/2024	$67.08	$12.70	$21.80	$0.00	$101.58
	03/01/2025	$68.88	$12.70	$21.80	$0.00	$103.38
For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER"						
HYDRAULIC DRILLS *LABORERS - ZONE 2*	12/01/2024	$40.61	$9.65	$17.70	$0.00	$67.96
	06/01/2025	$42.00	$9.65	$17.70	$0.00	$69.35
	12/01/2025	$43.38	$9.65	$17.70	$0.00	$70.73
	06/01/2026	$44.82	$9.65	$17.70	$0.00	$72.17
	12/01/2026	$46.26	$9.65	$17.70	$0.00	$73.61
	06/01/2027	$47.71	$9.65	$17.70	$0.00	$75.06
	12/01/2027	$49.16	$9.65	$17.70	$0.00	$76.51
	06/01/2028	$50.66	$9.65	$17.70	$0.00	$78.01
	12/01/2028	$52.16	$9.65	$17.70	$0.00	$79.51
For apprentice rates see "Apprentice- LABORER"						
HYDRAULIC DRILLS (HEAVY & HIGHWAY) *LABORERS - ZONE 2 (HEAVY & HIGHWAY)*	12/01/2024	$40.61	$9.65	$17.80	$0.00	$68.06
	06/01/2025	$42.00	$9.65	$17.80	$0.00	$69.45
	12/01/2025	$43.38	$9.65	$17.80	$0.00	$70.83
	06/01/2026	$44.82	$9.65	$17.80	$0.00	$72.27
	12/01/2026	$46.26	$9.65	$17.80	$0.00	$73.71
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
INSULATOR (PIPES & TANKS) *HEAT & FROST INSULATORS LOCAL 6 (BOSTON)*	09/01/2024	$56.92	$14.75	$19.61	$0.00	$91.28
	09/01/2025	$60.34	$14.75	$19.61	$0.00	$94.70
	09/01/2026	$63.76	$14.75	$19.61	$0.00	$98.12

Apprentice - *ASBESTOS INSULATOR (Pipes & Tanks) - Local 6 Boston*

Effective Date - 09/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$28.46	$14.75	$14.32	$0.00	$57.53
2	60	$34.15	$14.75	$15.37	$0.00	$64.27
3	70	$39.84	$14.75	$16.43	$0.00	$71.02
4	80	$45.54	$14.75	$17.49	$0.00	$77.78

Effective Date - 09/01/2025

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$30.17	$14.75	$14.32	$0.00	$59.24
2	60	$36.20	$14.75	$15.37	$0.00	$66.32
3	70	$42.24	$14.75	$16.43	$0.00	$73.42
4	80	$48.27	$14.75	$17.49	$0.00	$80.51

Notes:

Steps are 1 year

Apprentice to Journeyworker Ratio:1:4

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
IRONWORKER/WELDER *IRONWORKERS LOCAL 7 (LAWRENCE AREA)*	03/16/2024	$49.56	$8.35	$26.70	$0.00	$84.61

Apprentice - *IRONWORKER - Local 7 Lawrence*

Effective Date - 03/16/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	$29.74	$8.35	$26.70	$0.00	$64.79
2	70	$34.69	$8.35	$26.70	$0.00	$69.74
3	75	$37.17	$8.35	$26.70	$0.00	$72.22
4	80	$39.65	$8.35	$26.70	$0.00	$74.70
5	85	$42.13	$8.35	$26.70	$0.00	$77.18
6	90	$44.60	$8.35	$26.70	$0.00	$79.65

Notes:

Apprentice to Journeyworker Ratio:1:4

JACKHAMMER & PAVING BREAKER OPERATOR *LABORERS - ZONE 2*	12/01/2024	$40.11	$9.65	$17.70	$0.00	$67.46
	06/01/2025	$41.50	$9.65	$17.70	$0.00	$68.85
	12/01/2025	$42.88	$9.65	$17.70	$0.00	$70.23
	06/01/2026	$44.32	$9.65	$17.70	$0.00	$71.67
	12/01/2026	$45.76	$9.65	$17.70	$0.00	$73.11
	06/01/2027	$47.21	$9.65	$17.70	$0.00	$74.56
	12/01/2027	$48.66	$9.65	$17.70	$0.00	$76.01
	06/01/2028	$50.16	$9.65	$17.70	$0.00	$77.51
	12/01/2028	$51.66	$9.65	$17.70	$0.00	$79.01
For apprentice rates see "Apprentice- LABORER"						
LABORER *LABORERS - ZONE 2*	12/01/2024	$39.86	$9.65	$17.70	$0.00	$67.21
	06/01/2025	$41.25	$9.65	$17.70	$0.00	$68.60
	12/01/2025	$42.63	$9.65	$17.70	$0.00	$69.98
	06/01/2026	$44.07	$9.65	$17.70	$0.00	$71.42
	12/01/2026	$45.51	$9.65	$17.70	$0.00	$72.86
	06/01/2027	$46.96	$9.65	$17.70	$0.00	$74.31
	12/01/2027	$48.41	$9.65	$17.70	$0.00	$75.76
	06/01/2028	$49.91	$9.65	$17.70	$0.00	$77.26
	12/01/2028	$51.41	$9.65	$17.70	$0.00	$78.76

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *LABORER - Zone 2*

Effective Date - 12/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	$23.92	$9.65	$17.70	$0.00	$51.27
2	70	$27.90	$9.65	$17.70	$0.00	$55.25
3	80	$31.89	$9.65	$17.70	$0.00	$59.24
4	90	$35.87	$9.65	$17.70	$0.00	$63.22

Effective Date - 06/01/2025

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	$24.75	$9.65	$17.70	$0.00	$52.10
2	70	$28.88	$9.65	$17.70	$0.00	$56.23
3	80	$33.00	$9.65	$17.70	$0.00	$60.35
4	90	$37.13	$9.65	$17.70	$0.00	$64.48

Notes:

Apprentice to Journeyworker Ratio:1:5

LABORER (HEAVY & HIGHWAY) *LABORERS - ZONE 2 (HEAVY & HIGHWAY)*	12/01/2024	$39.86	$9.65	$17.80	$0.00	$67.31
	06/01/2025	$41.25	$9.65	$17.80	$0.00	$68.70
	12/01/2025	$42.63	$9.65	$17.80	$0.00	$70.08
	06/01/2026	$44.07	$9.65	$17.80	$0.00	$71.52
	12/01/2026	$45.51	$9.65	$17.80	$0.00	$72.96

Apprentice - *LABORER (Heavy & Highway) - Zone 2*

Effective Date - 12/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	$23.92	$9.65	$17.80	$0.00	$51.37
2	70	$27.90	$9.65	$17.80	$0.00	$55.35
3	80	$31.89	$9.65	$17.80	$0.00	$59.34
4	90	$35.87	$9.65	$17.80	$0.00	$63.32

Effective Date - 06/01/2025

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	$24.75	$9.65	$17.80	$0.00	$52.20
2	70	$28.88	$9.65	$17.80	$0.00	$56.33
3	80	$33.00	$9.65	$17.80	$0.00	$60.45
4	90	$37.13	$9.65	$17.80	$0.00	$64.58

Notes:

Apprentice to Journeyworker Ratio:1:5

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
LABORER: CARPENTER TENDER *LABORERS - ZONE 2*	12/01/2024	$39.86	$9.65	$17.70	$0.00	$67.21
	06/01/2025	$41.25	$9.65	$17.70	$0.00	$68.60
	12/01/2025	$42.63	$9.65	$17.70	$0.00	$69.98
	06/01/2026	$44.07	$9.65	$17.70	$0.00	$71.42
	12/01/2026	$45.51	$9.65	$17.70	$0.00	$72.86
	06/01/2027	$46.96	$9.65	$17.70	$0.00	$74.31
	12/01/2027	$48.41	$9.65	$17.70	$0.00	$75.76
	06/01/2028	$49.91	$9.65	$17.70	$0.00	$77.26
	12/01/2028	$51.41	$9.65	$17.70	$0.00	$78.76
For apprentice rates see "Apprentice- LABORER"						
LABORER: CEMENT FINISHER TENDER *LABORERS - ZONE 2*	12/01/2024	$39.86	$9.65	$17.70	$0.00	$67.21
	06/01/2025	$41.25	$9.65	$17.70	$0.00	$68.60
	12/01/2025	$42.63	$9.65	$17.70	$0.00	$69.98
	06/01/2026	$44.07	$9.65	$17.70	$0.00	$71.42
	12/01/2026	$45.51	$9.65	$17.70	$0.00	$72.86
	06/01/2027	$46.96	$9.65	$17.70	$0.00	$74.31
	12/01/2027	$48.41	$9.65	$17.70	$0.00	$75.76
	06/01/2028	$49.91	$9.65	$17.70	$0.00	$77.26
	12/01/2028	$51.41	$9.65	$17.70	$0.00	$78.76
For apprentice rates see "Apprentice- LABORER"						
LABORER: HAZARDOUS WASTE/ASBESTOS REMOVER *LABORERS - ZONE 2*	12/02/2024	$39.95	$9.65	$17.76	$0.00	$67.36
	06/02/2025	$41.34	$9.65	$17.76	$0.00	$68.75
	12/01/2025	$42.72	$9.65	$17.76	$0.00	$70.13
	06/01/2026	$44.16	$9.65	$17.76	$0.00	$71.57
	12/07/2026	$45.60	$9.65	$17.76	$0.00	$73.01
	06/07/2027	$47.05	$9.65	$17.76	$0.00	$74.46
	12/06/2027	$48.50	$9.65	$17.76	$0.00	$75.91
	06/05/2028	$50.00	$9.65	$17.76	$0.00	$77.41
	12/04/2028	$51.50	$9.65	$17.76	$0.00	$78.91
For apprentice rates see "Apprentice- LABORER"						
LABORER: MASON TENDER *LABORERS - ZONE 2*	12/01/2024	$40.11	$9.65	$17.70	$0.00	$67.46
	06/01/2025	$41.50	$9.65	$17.70	$0.00	$68.85
	12/01/2025	$42.88	$9.65	$17.70	$0.00	$70.23
	06/01/2026	$44.32	$9.65	$17.70	$0.00	$71.67
	12/01/2026	$45.76	$9.65	$17.70	$0.00	$73.11
	06/01/2027	$47.21	$9.65	$17.70	$0.00	$74.56
	12/01/2027	$48.66	$9.65	$17.70	$0.00	$76.01
	06/01/2028	$50.16	$9.65	$17.70	$0.00	$77.51
	12/01/2028	$51.66	$9.65	$17.70	$0.00	$79.01
For apprentice rates see "Apprentice- LABORER"						
LABORER: MASON TENDER (HEAVY & HIGHWAY) *LABORERS - ZONE 2 (HEAVY & HIGHWAY)*	12/01/2024	$40.11	$9.65	$17.80	$0.00	$67.56
	06/01/2025	$41.50	$9.65	$17.80	$0.00	$68.95
	12/01/2025	$42.88	$9.65	$17.80	$0.00	$70.33
	06/01/2026	$44.32	$9.65	$17.80	$0.00	$71.77
	12/01/2026	$45.76	$9.65	$17.80	$0.00	$73.21
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
LABORER: MULTI-TRADE TENDER *LABORERS - ZONE 2*	12/01/2024	$39.86	$9.65	$17.70	$0.00	$67.21
	06/01/2025	$41.25	$9.65	$17.70	$0.00	$68.60
	12/01/2025	$42.63	$9.65	$17.70	$0.00	$69.98
	06/01/2026	$44.07	$9.65	$17.70	$0.00	$71.42
	12/01/2026	$45.51	$9.65	$17.70	$0.00	$72.86
	06/01/2027	$46.96	$9.65	$17.70	$0.00	$74.31
	12/01/2027	$48.41	$9.65	$17.70	$0.00	$75.76
	06/01/2028	$49.91	$9.65	$17.70	$0.00	$77.26
	12/01/2028	$51.41	$9.65	$17.70	$0.00	$78.76
For apprentice rates see "Apprentice- LABORER"						
LABORER: TREE REMOVER *LABORERS - ZONE 2*	12/01/2024	$39.86	$9.65	$17.70	$0.00	$67.21
	06/01/2025	$41.25	$9.65	$17.70	$0.00	$68.60
	12/01/2025	$42.63	$9.65	$17.70	$0.00	$69.98
	06/01/2026	$44.07	$9.65	$17.70	$0.00	$71.42
	12/01/2026	$45.51	$9.65	$17.70	$0.00	$72.86
	06/01/2027	$46.96	$9.65	$17.70	$0.00	$74.31
	12/01/2027	$48.41	$9.65	$17.70	$0.00	$75.76
	06/01/2028	$49.91	$9.65	$17.70	$0.00	$77.26
	12/01/2028	$51.41	$9.65	$17.70	$0.00	$78.76
This classification applies to the removal of standing trees, and the trimming and removal of branches and limbs when related to public works construction or site clearance incidental to construction . For apprentice rates see "Apprentice- LABORER"						
LASER BEAM OPERATOR *LABORERS - ZONE 2*	12/01/2024	$40.11	$9.65	$17.70	$0.00	$67.46
	06/01/2025	$41.50	$9.65	$17.70	$0.00	$68.85
	12/01/2025	$42.88	$9.65	$17.70	$0.00	$70.23
	06/01/2026	$44.32	$9.65	$17.70	$0.00	$71.67
	12/01/2026	$45.76	$9.65	$17.70	$0.00	$73.11
	06/01/2027	$47.21	$9.65	$17.70	$0.00	$74.56
	12/01/2027	$48.66	$9.65	$17.70	$0.00	$76.01
	06/01/2028	$50.16	$9.65	$17.70	$0.00	$77.51
	12/01/2028	$51.66	$9.65	$17.70	$0.00	$79.01
For apprentice rates see "Apprentice- LABORER"						
LASER BEAM OPERATOR (HEAVY & HIGHWAY) *LABORERS - ZONE 2 (HEAVY & HIGHWAY)*	12/01/2024	$40.11	$9.65	$17.80	$0.00	$67.56
	06/01/2025	$41.50	$9.65	$17.80	$0.00	$68.95
	12/01/2025	$42.88	$9.65	$17.80	$0.00	$70.33
	06/01/2026	$44.32	$9.65	$17.80	$0.00	$71.77
	12/01/2026	$45.76	$9.65	$17.80	$0.00	$73.21
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
MARBLE & TILE FINISHERS *BRICKLAYERS LOCAL 3 - MARBLE & TILE*	08/01/2024	$49.32	$11.49	$21.62	$0.00	$82.43
	02/01/2025	$50.36	$11.49	$21.62	$0.00	$83.47
	08/01/2025	$52.08	$11.49	$21.62	$0.00	$85.19
	02/01/2026	$53.16	$11.49	$21.62	$0.00	$86.27
	08/01/2026	$54.92	$11.49	$21.62	$0.00	$88.03
	02/01/2027	$56.04	$11.49	$21.62	$0.00	$89.15

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *MARBLE & TILE FINISHER - Local 3 Marble & Tile*

Effective Date - 08/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$24.66	$11.49	$21.62	$0.00	$57.77
2	60	$29.59	$11.49	$21.62	$0.00	$62.70
3	70	$34.52	$11.49	$21.62	$0.00	$67.63
4	80	$39.46	$11.49	$21.62	$0.00	$72.57
5	90	$44.39	$11.49	$21.62	$0.00	$77.50

Effective Date - 02/01/2025

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$25.18	$11.49	$21.62	$0.00	$58.29
2	60	$30.22	$11.49	$21.62	$0.00	$63.33
3	70	$35.25	$11.49	$21.62	$0.00	$68.36
4	80	$40.29	$11.49	$21.62	$0.00	$73.40
5	90	$45.32	$11.49	$21.62	$0.00	$78.43

Notes:

Apprentice to Journeyworker Ratio:1:3

MARBLE MASONS,TILELAYERS & TERRAZZO MECH *BRICKLAYERS LOCAL 3 - MARBLE & TILE*	08/01/2024	$64.52	$11.49	$23.56	$0.00	$99.57
	02/01/2025	$65.82	$11.49	$23.56	$0.00	$100.87
	08/01/2025	$67.97	$11.49	$23.56	$0.00	$103.02
	02/01/2026	$69.32	$11.49	$23.56	$0.00	$104.37
	08/01/2026	$71.52	$11.49	$23.56	$0.00	$106.57
	02/01/2027	$72.92	$11.49	$23.56	$0.00	$107.97

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *MARBLE-TILE-TERRAZZO MECHANIC - Local 3 Marble & Tile*

Effective Date - 08/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$32.26	$11.49	$23.56	$0.00	$67.31
2	60	$38.71	$11.49	$23.56	$0.00	$73.76
3	70	$45.16	$11.49	$23.56	$0.00	$80.21
4	80	$51.62	$11.49	$23.56	$0.00	$86.67
5	90	$58.07	$11.49	$23.56	$0.00	$93.12

Effective Date - 02/01/2025

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$32.91	$11.49	$23.56	$0.00	$67.96
2	60	$39.49	$11.49	$23.56	$0.00	$74.54
3	70	$46.07	$11.49	$23.56	$0.00	$81.12
4	80	$52.66	$11.49	$23.56	$0.00	$87.71
5	90	$59.24	$11.49	$23.56	$0.00	$94.29

Notes:

Apprentice to Journeyworker Ratio:1:5

MECH. SWEEPER OPERATOR (ON CONST. SITES) *OPERATING ENGINEERS LOCAL 4*	12/01/2024	$56.40	$15.55	$16.50	$0.00	$88.45
	06/01/2025	$57.68	$15.55	$16.50	$0.00	$89.73
	12/01/2025	$59.12	$15.55	$16.50	$0.00	$91.17
	06/01/2026	$60.40	$15.55	$16.50	$0.00	$92.45
	12/01/2026	$61.84	$15.55	$16.50	$0.00	$93.89
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
MECHANICS MAINTENANCE *OPERATING ENGINEERS LOCAL 4*	12/01/2024	$56.40	$15.55	$16.50	$0.00	$88.45
	06/01/2025	$57.68	$15.55	$16.50	$0.00	$89.73
	12/01/2025	$59.12	$15.55	$16.50	$0.00	$91.17
	06/01/2026	$60.40	$15.55	$16.50	$0.00	$92.45
	12/01/2026	$61.84	$15.55	$16.50	$0.00	$93.89
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
MILLWRIGHT (Zone 2) *MILLWRIGHTS LOCAL 1121 - Zone 2*	01/06/2025	$45.09	$10.08	$21.47	$0.00	$76.64
	01/05/2026	$47.42	$10.08	$21.47	$0.00	$78.97

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *MILLWRIGHT - Local 1121 Zone 2*

Effective Date - 01/06/2025

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	55	$24.80	$10.08	$5.50	$0.00	$40.38
2	65	$29.31	$10.08	$6.50	$0.00	$45.89
3	75	$33.82	$10.08	$18.97	$0.00	$62.87
4	85	$38.33	$10.08	$19.97	$0.00	$68.38

Effective Date - 01/05/2026

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	55	$26.08	$10.08	$5.50	$0.00	$41.66
2	65	$30.82	$10.08	$6.50	$0.00	$47.40
3	75	$35.57	$10.08	$18.97	$0.00	$64.62
4	85	$40.31	$10.08	$19.97	$0.00	$70.36

Notes: Step 1&2 Appr. indentured after 1/6/2020 receive no pension, but do receive annuity. (Step 1 $5.72, Step 2 $6.66)
Steps are 2,000 hours

Apprentice to Journeyworker Ratio:1:4

MORTAR MIXER *LABORERS - ZONE 2*	12/01/2024	$40.11	$9.65	$17.70	$0.00	$67.46
	06/01/2025	$41.50	$9.65	$17.70	$0.00	$68.85
	12/01/2025	$42.88	$9.65	$17.70	$0.00	$70.23
	06/01/2026	$44.32	$9.65	$17.70	$0.00	$71.67
	12/01/2026	$45.76	$9.65	$17.70	$0.00	$73.11
	06/01/2027	$47.21	$9.65	$17.70	$0.00	$74.56
	12/01/2027	$48.66	$9.65	$17.70	$0.00	$76.01
	06/01/2028	$50.16	$9.65	$17.70	$0.00	$77.51
	12/01/2028	$51.66	$9.65	$17.70	$0.00	$79.01
For apprentice rates see "Apprentice- LABORER"						
OILER (OTHER THAN TRUCK CRANES,GRADALLS) *OPERATING ENGINEERS LOCAL 4*	12/01/2024	$25.37	$15.30	$16.40	$0.00	$57.07
	06/01/2025	$25.97	$15.30	$16.40	$0.00	$57.67
	12/01/2025	$26.63	$15.30	$16.40	$0.00	$58.33
	06/01/2026	$27.22	$15.30	$16.40	$0.00	$58.92
	12/01/2026	$27.89	$15.30	$16.40	$0.00	$59.59
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
OILER (TRUCK CRANES, GRADALLS) *OPERATING ENGINEERS LOCAL 4*	12/01/2024	$31.08	$15.30	$16.40	$0.00	$62.78
	06/01/2025	$31.80	$15.30	$16.40	$0.00	$63.50
	12/01/2025	$32.60	$15.30	$16.40	$0.00	$64.30
	06/01/2026	$33.32	$15.30	$16.40	$0.00	$65.02
	12/01/2026	$34.12	$15.30	$16.40	$0.00	$65.82
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
OTHER POWER DRIVEN EQUIPMENT - CLASS II *OPERATING ENGINEERS LOCAL 4*	12/01/2024	$56.40	$15.55	$16.50	$0.00	$88.45
	06/01/2025	$57.68	$15.55	$16.50	$0.00	$89.73
	12/01/2025	$59.12	$15.55	$16.50	$0.00	$91.17
	06/01/2026	$60.40	$15.55	$16.50	$0.00	$92.45
	12/01/2026	$61.84	$15.55	$16.50	$0.00	$93.89
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
PAINTER (BRIDGES/TANKS) *PAINTERS LOCAL 35 - ZONE 2*	01/01/2025	$58.46	$9.95	$23.95	$0.00	$92.36

Apprentice - *PAINTER Local 35 - BRIDGES/TANKS*

Effective Date - 01/01/2025

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$29.23	$9.95	$0.00	$0.00	$39.18
2	55	$32.15	$9.95	$6.66	$0.00	$48.76
3	60	$35.08	$9.95	$7.26	$0.00	$52.29
4	65	$38.00	$9.95	$7.87	$0.00	$55.82
5	70	$40.92	$9.95	$20.32	$0.00	$71.19
6	75	$43.85	$9.95	$20.93	$0.00	$74.73
7	80	$46.77	$9.95	$21.53	$0.00	$78.25
8	90	$52.61	$9.95	$22.74	$0.00	$85.30

Notes:

Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER (SPRAY OR SANDBLAST, NEW) * * If 30% or more of surfaces to be painted are new construction, NEW paint rate shall be used.*PAINTERS LOCAL 35 - ZONE 2*	01/01/2025	$49.36	$9.95	$23.95	$0.00	$83.26

Apprentice - *PAINTER Local 35 Zone 2 - Spray/Sandblast - New*

Effective Date - 01/01/2025

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$24.68	$9.95	$0.00	$0.00	$34.63
2	55	$27.15	$9.95	$6.66	$0.00	$43.76
3	60	$29.62	$9.95	$7.26	$0.00	$46.83
4	65	$32.08	$9.95	$7.87	$0.00	$49.90
5	70	$34.55	$9.95	$20.32	$0.00	$64.82
6	75	$37.02	$9.95	$20.93	$0.00	$67.90
7	80	$39.49	$9.95	$21.53	$0.00	$70.97
8	90	$44.42	$9.95	$22.74	$0.00	$77.11

Notes:

Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
PAINTER (SPRAY OR SANDBLAST, REPAINT) *PAINTERS LOCAL 35 - ZONE 2*	01/01/2025	$47.42	$9.95	$23.95	$0.00	$81.32

Apprentice - *PAINTER Local 35 Zone 2 - Spray/Sandblast - Repaint*

Effective Date - 01/01/2025

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$23.71	$9.95	$0.00	$0.00	$33.66
2	55	$26.08	$9.95	$6.66	$0.00	$42.69
3	60	$28.45	$9.95	$7.26	$0.00	$45.66
4	65	$30.82	$9.95	$7.87	$0.00	$48.64
5	70	$33.19	$9.95	$20.32	$0.00	$63.46
6	75	$35.57	$9.95	$20.93	$0.00	$66.45
7	80	$37.94	$9.95	$21.53	$0.00	$69.42
8	90	$42.68	$9.95	$22.74	$0.00	$75.37

Notes:
Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER / TAPER (BRUSH, NEW) * * If 30% or more of surfaces to be painted are new construction, NEW paint rate shall be used.*PAINTERS LOCAL 35 - ZONE 2*	01/01/2025	$47.96	$9.95	$23.95	$0.00	$81.86

Apprentice - *PAINTER - Local 35 Zone 2 - BRUSH NEW*

Effective Date - 01/01/2025

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$23.98	$9.95	$0.00	$0.00	$33.93
2	55	$26.38	$9.95	$6.66	$0.00	$42.99
3	60	$28.78	$9.95	$7.26	$0.00	$45.99
4	65	$31.17	$9.95	$7.87	$0.00	$48.99
5	70	$33.57	$9.95	$20.32	$0.00	$63.84
6	75	$35.97	$9.95	$20.93	$0.00	$66.85
7	80	$38.37	$9.95	$21.53	$0.00	$69.85
8	90	$43.16	$9.95	$22.74	$0.00	$75.85

Notes:
Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER / TAPER (BRUSH, REPAINT) *PAINTERS LOCAL 35 - ZONE 2*	01/01/2025	$46.02	$9.95	$23.95	$0.00	$79.92

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *PAINTER Local 35 Zone 2 - BRUSH REPAINT*

Effective Date - 01/01/2025

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$23.01	$9.95	$0.00	$0.00	$32.96
2	55	$25.31	$9.95	$6.66	$0.00	$41.92
3	60	$27.61	$9.95	$7.26	$0.00	$44.82
4	65	$29.91	$9.95	$7.87	$0.00	$47.73
5	70	$32.21	$9.95	$20.32	$0.00	$62.48
6	75	$34.52	$9.95	$20.93	$0.00	$65.40
7	80	$36.82	$9.95	$21.53	$0.00	$68.30
8	90	$41.42	$9.95	$22.74	$0.00	$74.11

Notes:
Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER TRAFFIC MARKINGS (HEAVY/HIGHWAY) *LABORERS - ZONE 2 (HEAVY & HIGHWAY)*	12/01/2024	$39.86	$9.65	$17.80	$0.00	$67.31
	06/01/2025	$41.25	$9.65	$17.80	$0.00	$68.70
	12/01/2025	$42.63	$9.65	$17.80	$0.00	$70.08
	06/01/2026	$44.07	$9.65	$17.80	$0.00	$71.52
	12/01/2026	$45.51	$9.65	$17.80	$0.00	$72.96
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
PANEL & PICKUP TRUCKS DRIVER *TEAMSTERS JOINT COUNCIL NO. 10 ZONE B*	01/01/2025	$39.78	$15.57	$20.17	$0.00	$75.52
	06/01/2025	$40.78	$15.57	$20.17	$0.00	$76.52
	12/01/2025	$40.78	$15.57	$21.78	$0.00	$78.13
	01/01/2026	$40.78	$16.17	$21.78	$0.00	$78.73
	06/01/2026	$41.78	$16.17	$21.78	$0.00	$79.73
	12/01/2026	$41.78	$16.17	$23.52	$0.00	$81.47
	01/01/2027	$41.78	$16.77	$23.52	$0.00	$82.07
PIER AND DOCK CONSTRUCTOR (UNDERPINNING AND DECK) *PILE DRIVER LOCAL 56 (ZONE 1)*	08/01/2024	$55.79	$10.08	$24.29	$0.00	$90.16
For apprentice rates see "Apprentice- PILE DRIVER"						
PILE DRIVER *PILE DRIVER LOCAL 56 (ZONE 1)*	08/01/2024	$55.79	$10.08	$24.29	$0.00	$90.16

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *PILE DRIVER - Local 56 Zone 1*

Effective Date - 08/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	45	$25.11	$10.08	$2.53	$0.00	$37.72
2	55	$30.68	$10.08	$5.07	$0.00	$45.83
3	70	$39.05	$10.08	$19.22	$0.00	$68.35
4	80	$44.63	$10.08	$21.76	$0.00	$76.47

Notes:

% Indentured BEFORE 8/1/20; 50/60/70/75/80/80/90/90

Step 1 $62.27/ 2 $67.84/ 3 $73.42/ 4 $76.21/ 5&6 $79.00/ 7&8 $84.58

Apprentice to Journeyworker Ratio:1:5

PIPEFITTER & STEAMFITTER *PIPEFITTERS LOCAL 537*	09/01/2024	$67.08	$12.70	$21.80	$0.00	$101.58
	03/01/2025	$68.88	$12.70	$21.80	$0.00	$103.38

Apprentice - *PIPEFITTER - Local 537*

Effective Date - 09/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	$26.83	$12.70	$9.05	$0.00	$48.58
2	45	$30.19	$12.70	$21.80	$0.00	$64.69
3	60	$40.25	$12.70	$21.80	$0.00	$74.75
4	70	$46.96	$12.70	$21.80	$0.00	$81.46
5	80	$53.66	$12.70	$21.80	$0.00	$88.16

Effective Date - 03/01/2025

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	$27.55	$12.70	$9.05	$0.00	$49.30
2	45	$31.00	$12.70	$21.80	$0.00	$65.50
3	60	$41.33	$12.70	$21.80	$0.00	$75.83
4	70	$48.22	$12.70	$21.80	$0.00	$82.72
5	80	$55.10	$12.70	$21.80	$0.00	$89.60

Notes:

** 1:3; 3:15; 1:10 thereafter / Steps are 1 yr.

Refrig/AC Mechanic **1:1;1:2;2:4;3:6;4:8;5:10;6:12;7:14;8:17;9:20;10:23(Max)

Apprentice to Journeyworker Ratio:**

PIPELAYER *LABORERS - ZONE 2*	12/01/2024	$40.11	$9.65	$17.70	$0.00	$67.46
	06/01/2025	$41.50	$9.65	$17.70	$0.00	$68.85
	12/01/2025	$42.88	$9.65	$17.70	$0.00	$70.23
	06/01/2026	$44.32	$9.65	$17.70	$0.00	$71.67
	12/01/2026	$45.76	$9.65	$17.70	$0.00	$73.11
	06/01/2027	$47.21	$9.65	$17.70	$0.00	$74.56
	12/01/2027	$48.66	$9.65	$17.70	$0.00	$76.01
	06/01/2028	$50.16	$9.65	$17.70	$0.00	$77.51
	12/01/2028	$51.66	$9.65	$17.70	$0.00	$79.01

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
For apprentice rates see "Apprentice- LABORER"						
PIPELAYER (HEAVY & HIGHWAY) *LABORERS - ZONE 2 (HEAVY & HIGHWAY)*	12/01/2024	$40.11	$9.65	$17.80	$0.00	$67.56
	06/01/2025	$41.50	$9.65	$17.80	$0.00	$68.95
	12/01/2025	$42.88	$9.65	$17.80	$0.00	$70.33
	06/01/2026	$44.32	$9.65	$17.80	$0.00	$71.77
	12/01/2026	$45.76	$9.65	$17.80	$0.00	$73.21
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
PLUMBERS & GASFITTERS *PLUMBERS & GASFITTERS LOCAL 12*	09/01/2024	$69.04	$14.32	$19.61	$0.00	$102.97
	03/02/2025	$70.84	$14.32	$19.61	$0.00	$104.77

Apprentice - *PLUMBER/GASFITTER - Local 12*

Effective Date - 09/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	35	$24.16	$14.32	$7.06	$0.00	$45.54
2	40	$27.62	$14.32	$8.02	$0.00	$49.96
3	55	$37.97	$14.32	$10.93	$0.00	$63.22
4	65	$44.88	$14.32	$12.86	$0.00	$72.06
5	75	$51.78	$14.32	$14.79	$0.00	$80.89

Effective Date - 03/02/2025

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	35	$24.79	$14.32	$7.06	$0.00	$46.17
2	40	$28.34	$14.32	$8.02	$0.00	$50.68
3	55	$38.96	$14.32	$10.93	$0.00	$64.21
4	65	$46.05	$14.32	$12.86	$0.00	$73.23
5	75	$53.13	$14.32	$14.79	$0.00	$82.24

Notes:

** 1:2; 2:6; 3:10; 4:14; 5:19/Steps are 1 yr

Step4 with lic$76.49 tot.rate, Step5 with lic. $85.32 tot. rate

Apprentice to Journeyworker Ratio:**

PNEUMATIC CONTROLS (TEMP.) *PIPEFITTERS LOCAL 537*	09/01/2024	$67.08	$12.70	$21.80	$0.00	$101.58
	03/01/2025	$68.88	$12.70	$21.80	$0.00	$103.38
For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER"						
PNEUMATIC DRILL/TOOL OPERATOR *LABORERS - ZONE 2*	12/01/2024	$40.61	$9.65	$17.70	$0.00	$67.96
	06/01/2025	$42.00	$9.65	$17.70	$0.00	$69.35
	12/01/2025	$43.38	$9.65	$17.70	$0.00	$70.73
	06/01/2026	$44.82	$9.65	$17.70	$0.00	$72.17
	12/01/2026	$46.26	$9.65	$17.70	$0.00	$73.61
	06/01/2027	$47.71	$9.65	$17.70	$0.00	$75.06
	12/01/2027	$49.16	$9.65	$17.70	$0.00	$76.51
	06/01/2028	$50.66	$9.65	$17.70	$0.00	$78.01
	12/01/2028	$52.16	$9.65	$17.70	$0.00	$79.51
For apprentice rates see "Apprentice- LABORER"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
PNEUMATIC DRILL/TOOL OPERATOR (HEAVY & HIGHWAY) *LABORERS - ZONE 2 (HEAVY & HIGHWAY)*	12/01/2024	$40.11	$9.65	$17.80	$0.00	$67.56
	06/01/2025	$41.50	$9.65	$17.80	$0.00	$68.95
	12/01/2025	$42.88	$9.65	$17.80	$0.00	$70.33
	06/01/2026	$44.32	$9.65	$17.80	$0.00	$71.77
	12/01/2026	$45.76	$9.65	$17.80	$0.00	$73.21
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)						
POWDERMAN & BLASTER *LABORERS - ZONE 2*	12/01/2024	$40.86	$9.65	$17.70	$0.00	$68.21
	06/01/2025	$42.25	$9.65	$17.70	$0.00	$69.60
	12/01/2025	$43.63	$9.65	$17.70	$0.00	$70.98
	06/01/2026	$45.07	$9.65	$17.70	$0.00	$72.42
	12/01/2026	$46.51	$9.65	$17.70	$0.00	$73.86
	06/01/2027	$47.96	$9.65	$17.70	$0.00	$75.31
	12/01/2027	$49.41	$9.65	$17.70	$0.00	$76.76
	06/01/2028	$50.91	$9.65	$17.70	$0.00	$78.26
	12/01/2028	$52.41	$9.65	$17.70	$0.00	$79.76
For apprentice rates see "Apprentice- LABORER"						
POWDERMAN & BLASTER (HEAVY & HIGHWAY) *LABORERS - ZONE 2 (HEAVY & HIGHWAY)*	12/01/2024	$40.86	$9.40	$17.55	$0.00	$67.81
	06/01/2025	$42.25	$9.40	$17.55	$0.00	$69.20
	12/01/2025	$43.63	$9.40	$17.55	$0.00	$70.58
	06/01/2026	$45.07	$9.40	$17.55	$0.00	$72.02
	12/01/2026	$46.51	$9.40	$17.55	$0.00	$73.46
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)						
POWER SHOVEL/DERRICK/TRENCHING MACHINE *OPERATING ENGINEERS LOCAL 4*	12/01/2024	$57.03	$15.55	$16.50	$0.00	$89.08
	06/01/2025	$58.33	$15.55	$16.50	$0.00	$90.38
	12/01/2025	$59.78	$15.55	$16.50	$0.00	$91.83
	06/01/2026	$61.08	$15.55	$16.50	$0.00	$93.13
	12/01/2026	$62.53	$15.55	$16.50	$0.00	$94.58
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
PUMP OPERATOR (CONCRETE) *OPERATING ENGINEERS LOCAL 4*	12/01/2024	$56.40	$15.55	$16.50	$0.00	$88.45
	06/01/2025	$57.68	$15.55	$16.50	$0.00	$89.73
	12/01/2025	$59.12	$15.55	$16.50	$0.00	$91.17
	06/01/2026	$60.40	$15.55	$16.50	$0.00	$92.45
	12/01/2026	$61.84	$15.55	$16.50	$0.00	$93.89
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
PUMP OPERATOR (DEWATERING, OTHER) *OPERATING ENGINEERS LOCAL 4*	12/01/2024	$36.67	$15.55	$16.50	$0.00	$68.72
	06/01/2025	$37.52	$15.55	$16.50	$0.00	$69.57
	12/01/2025	$38.47	$15.55	$16.50	$0.00	$70.52
	06/01/2026	$39.33	$15.55	$16.50	$0.00	$71.38
	12/01/2026	$40.28	$15.55	$16.50	$0.00	$72.33
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
READY-MIX CONCRETE DRIVER *TEAMSTERS 170 - J.G. MacLellan (Lowell)*	01/01/2025	$30.00	$11.57	$6.55	$0.00	$48.12
	05/01/2025	$30.50	$11.57	$6.65	$0.00	$48.72
	01/01/2026	$30.50	$11.97	$6.65	$0.00	$49.12

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
RECLAIMERS *OPERATING ENGINEERS LOCAL 4*	12/01/2024	$56.40	$15.55	$16.50	$0.00	$88.45
	06/01/2025	$57.68	$15.55	$16.50	$0.00	$89.73
	12/01/2025	$59.12	$15.55	$16.50	$0.00	$91.17
	06/01/2026	$60.40	$15.55	$16.50	$0.00	$92.45
	12/01/2026	$61.84	$15.55	$16.50	$0.00	$93.89
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
RIDE-ON MOTORIZED BUGGY OPERATOR *LABORERS - ZONE 2*	12/01/2024	$40.11	$9.65	$17.70	$0.00	$67.46
	06/01/2025	$41.50	$9.65	$17.70	$0.00	$68.85
	12/01/2025	$42.88	$9.65	$17.70	$0.00	$70.23
	06/01/2026	$44.32	$9.65	$17.70	$0.00	$71.67
	12/01/2026	$45.76	$9.65	$17.70	$0.00	$73.11
	06/01/2027	$47.21	$9.65	$17.70	$0.00	$74.56
	12/01/2027	$48.66	$9.65	$17.70	$0.00	$76.01
	06/01/2028	$50.16	$9.65	$17.70	$0.00	$77.51
	12/01/2028	$51.66	$9.65	$17.70	$0.00	$79.01
For apprentice rates see "Apprentice- LABORER"						
ROLLER/SPREADER/MULCHING MACHINE *OPERATING ENGINEERS LOCAL 4*	12/01/2024	$56.40	$15.55	$16.50	$0.00	$88.45
	06/01/2025	$57.68	$15.55	$16.50	$0.00	$89.73
	12/01/2025	$59.12	$15.55	$16.50	$0.00	$91.17
	06/01/2026	$60.40	$15.55	$16.50	$0.00	$92.45
	12/01/2026	$61.84	$15.55	$16.50	$0.00	$93.89
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
ROOFER (Inc.Roofer Waterproofng &Roofer Damproofg) *ROOFERS LOCAL 33*	08/01/2024	$51.03	$13.03	$21.70	$0.00	$85.76
	02/01/2025	$52.28	$13.03	$21.70	$0.00	$87.01
	08/01/2025	$53.78	$13.03	$21.70	$0.00	$88.51
	02/01/2026	$55.03	$13.03	$21.70	$0.00	$89.76

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *ROOFER - Local 33*

Effective Date - 08/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$25.52	$13.03	$6.52	$0.00	$45.07
2	60	$30.62	$13.03	$21.70	$0.00	$65.35
3	65	$33.17	$13.03	$21.70	$0.00	$67.90
4	75	$38.27	$13.03	$21.70	$0.00	$73.00
5	85	$43.38	$13.03	$21.70	$0.00	$78.11

Effective Date - 02/01/2025

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$26.14	$13.03	$6.52	$0.00	$45.69
2	60	$31.37	$13.03	$21.70	$0.00	$66.10
3	65	$33.98	$13.03	$21.70	$0.00	$68.71
4	75	$39.21	$13.03	$21.70	$0.00	$73.94
5	85	$44.44	$13.03	$21.70	$0.00	$79.17

Notes: ** 1:5, 2:6-10, the 1:10; Reroofing: 1:4, then 1:1
Step 1 is 2000 hrs.; Steps 2-5 are 1000 hrs.
(Hot Pitch Mechanics' receive $1.00 hr. above ROOFER)

Apprentice to Journeyworker Ratio:**

ROOFER SLATE / TILE / PRECAST CONCRETE *ROOFERS LOCAL 33*	08/01/2024	$51.28	$13.03	$21.70	$0.00	$86.01
	02/01/2025	$52.53	$13.03	$21.70	$0.00	$87.26
	08/01/2025	$54.03	$13.03	$21.70	$0.00	$88.76
	02/01/2026	$55.28	$13.03	$21.70	$0.00	$90.01
For apprentice rates see "Apprentice- ROOFER"						
SHEETMETAL WORKER *SHEETMETAL WORKERS LOCAL 17 - A*	08/01/2024	$57.94	$14.75	$28.12	$2.98	$103.79
	02/01/2025	$59.69	$14.75	$28.12	$2.98	$105.54
	08/01/2025	$61.54	$14.75	$28.12	$2.98	$107.39
	02/01/2026	$63.49	$14.75	$28.12	$2.98	$109.34

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *SHEET METAL WORKER - Local 17-A*

Effective Date - 08/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	42	$24.33	$14.75	$6.13	$0.00	$45.21
2	42	$24.33	$14.75	$6.13	$0.00	$45.21
3	47	$27.23	$14.75	$12.11	$1.63	$55.72
4	47	$27.23	$14.75	$12.11	$1.63	$55.72
5	52	$30.13	$14.75	$13.09	$1.75	$59.72
6	52	$30.13	$14.75	$13.34	$1.76	$59.98
7	60	$34.76	$14.75	$14.75	$1.94	$66.20
8	65	$37.66	$14.75	$15.73	$2.06	$70.20
9	75	$43.46	$14.75	$17.69	$2.30	$78.20
10	85	$49.25	$14.75	$19.15	$2.52	$85.67

Effective Date - 02/01/2025

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	42	$25.07	$14.75	$6.13	$0.00	$45.95
2	42	$25.07	$14.75	$6.13	$0.00	$45.95
3	47	$28.05	$14.75	$12.11	$1.66	$56.57
4	47	$28.05	$14.75	$12.11	$1.66	$56.57
5	52	$31.04	$14.75	$13.09	$1.78	$60.66
6	52	$31.04	$14.75	$13.34	$1.79	$60.92
7	60	$35.81	$14.75	$14.75	$1.97	$67.28
8	65	$38.80	$14.75	$15.73	$2.09	$71.37
9	75	$44.77	$14.75	$17.69	$2.33	$79.54
10	85	$50.74	$14.75	$19.15	$2.56	$87.20

Notes:
Steps are 6 mos.

Apprentice to Journeyworker Ratio:1:4

SPECIALIZED EARTH MOVING EQUIP < 35 TONS *TEAMSTERS JOINT COUNCIL NO. 10 ZONE B*	01/01/2025	$40.24	$15.57	$20.17	$0.00	$75.98
	06/01/2025	$41.24	$15.57	$20.17	$0.00	$76.98
	12/01/2025	$41.24	$15.57	$21.78	$0.00	$78.59
	01/01/2026	$41.24	$16.17	$21.78	$0.00	$79.19
	06/01/2026	$42.24	$16.17	$21.78	$0.00	$80.19
	12/01/2026	$42.24	$16.17	$23.52	$0.00	$81.93
	01/01/2027	$42.24	$16.77	$23.52	$0.00	$82.53

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
SPECIALIZED EARTH MOVING EQUIP > 35 TONS *TEAMSTERS JOINT COUNCIL NO. 10 ZONE B*	01/01/2025	$40.53	$15.57	$20.17	$0.00	$76.27
	06/01/2025	$41.53	$15.57	$20.17	$0.00	$77.27
	12/01/2025	$41.53	$15.57	$21.78	$0.00	$78.88
	01/01/2026	$41.53	$16.17	$21.78	$0.00	$79.48
	06/01/2026	$42.53	$16.17	$21.78	$0.00	$80.48
	12/01/2026	$42.53	$16.17	$23.52	$0.00	$82.22
	01/01/2027	$42.53	$16.77	$23.52	$0.00	$82.82
SPRINKLER FITTER *SPRINKLER FITTERS LOCAL 550 - (Section A) Zone 1*	10/01/2024	$70.34	$11.51	$23.80	$0.00	$105.65
	03/01/2025	$72.14	$11.51	$23.80	$0.00	$107.45

Apprentice - *SPRINKLER FITTER - Local 550 (Section A) Zone 1*

Effective Date - 10/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	35	$24.62	$11.51	$13.07	$0.00	$49.20
2	40	$28.14	$11.51	$13.90	$0.00	$53.55
3	45	$31.65	$11.51	$14.73	$0.00	$57.89
4	50	$35.17	$11.51	$15.55	$0.00	$62.23
5	55	$38.69	$11.51	$16.37	$0.00	$66.57
6	60	$42.20	$11.51	$17.20	$0.00	$70.91
7	65	$45.72	$11.51	$18.03	$0.00	$75.26
8	70	$49.24	$11.51	$18.85	$0.00	$79.60
9	75	$52.76	$11.51	$19.67	$0.00	$83.94
10	80	$56.27	$11.51	$20.50	$0.00	$88.28

Effective Date - 03/01/2025

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	35	$25.25	$11.51	$13.07	$0.00	$49.83
2	40	$28.86	$11.51	$13.90	$0.00	$54.27
3	45	$32.46	$11.51	$14.73	$0.00	$58.70
4	50	$36.07	$11.51	$15.55	$0.00	$63.13
5	55	$39.68	$11.51	$16.37	$0.00	$67.56
6	60	$43.28	$11.51	$17.20	$0.00	$71.99
7	65	$46.89	$11.51	$18.03	$0.00	$76.43
8	70	$50.50	$11.51	$18.85	$0.00	$80.86
9	75	$54.11	$11.51	$19.67	$0.00	$85.29
10	80	$57.71	$11.51	$20.50	$0.00	$89.72

Notes: Apprentice entered prior 9/30/10:
40/45/50/55/60/65/70/75/80/85
Steps are 850 hours

Apprentice to Journeyworker Ratio:1:3

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
STEAM BOILER OPERATOR *OPERATING ENGINEERS LOCAL 4*	12/01/2024	$56.40	$15.55	$16.50	$0.00	$88.45
	06/01/2025	$57.68	$15.55	$16.50	$0.00	$89.73
	12/01/2025	$59.12	$15.55	$16.50	$0.00	$91.17
	06/01/2026	$60.40	$15.55	$16.50	$0.00	$92.45
	12/01/2026	$61.84	$15.55	$16.50	$0.00	$93.89
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
TAMPERS, SELF-PROPELLED OR TRACTOR DRAWN *OPERATING ENGINEERS LOCAL 4*	12/01/2024	$56.40	$15.55	$16.50	$0.00	$88.45
	06/01/2025	$57.68	$15.55	$16.50	$0.00	$89.73
	12/01/2025	$59.12	$15.55	$16.50	$0.00	$91.17
	06/01/2026	$60.40	$15.55	$16.50	$0.00	$92.45
	12/01/2026	$61.84	$15.55	$16.50	$0.00	$93.89
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
TELECOMMUNICATION TECHNICIAN *ELECTRICIANS LOCAL 103*	09/01/2024	$51.02	$13.00	$20.24	$0.00	$84.26
	03/01/2025	$51.98	$13.00	$20.27	$0.00	$85.25
	09/01/2025	$53.51	$13.00	$20.32	$0.00	$86.83
	03/01/2026	$54.47	$13.00	$20.34	$0.00	$87.81
	09/01/2026	$56.00	$13.00	$20.39	$0.00	$89.39
	03/01/2027	$56.95	$13.00	$20.42	$0.00	$90.37
	09/01/2027	$58.49	$13.00	$20.46	$0.00	$91.95
	03/01/2028	$59.45	$13.00	$20.49	$0.00	$92.94

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *TELECOMMUNICATION TECHNICIAN - Local 103*

Effective Date - 09/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	45	$22.96	$13.00	$0.69	$0.00	$36.65
2	45	$22.96	$13.00	$0.69	$0.00	$36.65
3	50	$25.51	$13.00	$16.16	$0.00	$54.67
4	50	$25.51	$13.00	$16.16	$0.00	$54.67
5	55	$28.06	$13.00	$16.57	$0.00	$57.63
6	60	$30.61	$13.00	$16.97	$0.00	$60.58
7	65	$33.16	$13.00	$17.38	$0.00	$63.54
8	70	$35.71	$13.00	$17.78	$0.00	$66.49
9	75	$38.27	$13.00	$18.18	$0.00	$69.45
10	80	$40.82	$13.00	$18.58	$0.00	$72.40

Effective Date - 03/01/2025

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	45	$23.39	$13.00	$0.70	$0.00	$37.09
2	45	$23.39	$13.00	$0.70	$0.00	$37.09
3	50	$25.99	$13.00	$16.16	$0.00	$55.15
4	50	$25.99	$13.00	$16.16	$0.00	$55.15
5	55	$28.59	$13.00	$16.57	$0.00	$58.16
6	60	$31.19	$13.00	$16.97	$0.00	$61.16
7	65	$33.79	$13.00	$17.38	$0.00	$64.17
8	70	$36.39	$13.00	$17.78	$0.00	$67.17
9	75	$38.99	$13.00	$18.18	$0.00	$70.17
10	80	$41.58	$13.00	$18.58	$0.00	$73.16

Notes:

Apprentice to Journeyworker Ratio:1:1

TERRAZZO FINISHERS *BRICKLAYERS LOCAL 3 - MARBLE & TILE*	08/01/2024	$63.44	$11.49	$23.59	$0.00	$98.52
	02/01/2025	$64.74	$11.49	$23.59	$0.00	$99.82
	08/01/2025	$66.89	$11.49	$23.59	$0.00	$101.97
	02/01/2026	$68.24	$11.49	$23.59	$0.00	$103.32
	08/01/2026	$70.44	$11.49	$23.59	$0.00	$105.52
	02/01/2027	$71.84	$11.49	$23.59	$0.00	$106.92

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *TERRAZZO FINISHER - Local 3 Marble & Tile*

Effective Date - 08/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$31.72	$11.49	$23.59	$0.00	$66.80
2	60	$38.06	$11.49	$23.59	$0.00	$73.14
3	70	$44.41	$11.49	$23.59	$0.00	$79.49
4	80	$50.75	$11.49	$23.59	$0.00	$85.83
5	90	$57.10	$11.49	$23.59	$0.00	$92.18

Effective Date - 02/01/2025

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$32.37	$11.49	$23.59	$0.00	$67.45
2	60	$38.84	$11.49	$23.59	$0.00	$73.92
3	70	$45.32	$11.49	$23.59	$0.00	$80.40
4	80	$51.79	$11.49	$23.59	$0.00	$86.87
5	90	$58.27	$11.49	$23.59	$0.00	$93.35

Notes:

Apprentice to Journeyworker Ratio:1:3

TEST BORING DRILLER *LABORERS - FOUNDATION AND MARINE*	12/01/2024	$51.28	$9.65	$18.22	$0.00	$79.15
	06/01/2025	$52.78	$9.65	$18.22	$0.00	$80.65
	12/01/2025	$54.28	$9.65	$18.22	$0.00	$82.15
	06/01/2026	$55.83	$9.65	$18.22	$0.00	$83.70
	12/01/2026	$57.33	$9.65	$18.22	$0.00	$85.20
For apprentice rates see "Apprentice- LABORER"						
TEST BORING DRILLER HELPER *LABORERS - FOUNDATION AND MARINE*	12/01/2024	$47.07	$9.65	$18.22	$0.00	$74.94
	06/01/2025	$48.57	$9.65	$18.22	$0.00	$76.44
	12/01/2025	$50.07	$9.65	$18.22	$0.00	$77.94
	06/01/2026	$51.62	$9.65	$18.22	$0.00	$79.49
	12/01/2026	$53.12	$9.65	$18.22	$0.00	$80.99
For apprentice rates see "Apprentice- LABORER"						
TEST BORING LABORER *LABORERS - FOUNDATION AND MARINE*	12/01/2024	$46.95	$9.65	$18.22	$0.00	$74.82
	06/01/2025	$48.45	$9.65	$18.22	$0.00	$76.32
	12/01/2025	$49.95	$9.65	$18.22	$0.00	$77.82
	06/01/2026	$51.50	$9.65	$18.22	$0.00	$79.37
	12/01/2026	$53.00	$9.65	$18.22	$0.00	$80.87
For apprentice rates see "Apprentice- LABORER"						
TRACTORS/PORTABLE STEAM GENERATORS *OPERATING ENGINEERS LOCAL 4*	12/01/2024	$56.40	$15.55	$16.50	$0.00	$88.45
	06/01/2025	$57.68	$15.55	$16.50	$0.00	$89.73
	12/01/2025	$59.12	$15.55	$16.50	$0.00	$91.17
	06/01/2026	$60.40	$15.55	$16.50	$0.00	$92.45
	12/01/2026	$61.84	$15.55	$16.50	$0.00	$93.89
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
TRAILERS FOR EARTH MOVING EQUIPMENT *TEAMSTERS JOINT COUNCIL NO. 10 ZONE B*	01/01/2025	$40.82	$15.57	$20.17	$0.00	$76.56
	06/01/2025	$41.82	$15.57	$20.17	$0.00	$77.56
	12/01/2025	$41.82	$15.57	$21.78	$0.00	$79.17
	01/01/2026	$41.82	$16.17	$21.78	$0.00	$79.77
	06/01/2026	$42.82	$16.17	$21.78	$0.00	$80.77
	12/01/2026	$42.82	$16.17	$23.52	$0.00	$82.51
	01/01/2027	$42.82	$16.77	$23.52	$0.00	$83.11
TUNNEL WORK - COMPRESSED AIR *LABORERS (COMPRESSED AIR)*	12/01/2024	$59.18	$9.65	$19.00	$0.00	$87.83
	06/01/2025	$60.68	$9.65	$19.00	$0.00	$89.33
	12/01/2025	$62.18	$9.65	$19.00	$0.00	$90.83
	06/01/2026	$63.73	$9.65	$19.00	$0.00	$92.38
	12/01/2026	$65.23	$9.65	$19.00	$0.00	$93.88
For apprentice rates see "Apprentice- LABORER"						
TUNNEL WORK - COMPRESSED AIR (HAZ. WASTE) *LABORERS (COMPRESSED AIR)*	12/01/2024	$61.18	$9.65	$19.00	$0.00	$89.83
	06/01/2025	$62.68	$9.65	$19.00	$0.00	$91.33
	12/01/2025	$64.18	$9.65	$19.00	$0.00	$92.83
	06/01/2026	$65.73	$9.65	$19.00	$0.00	$94.38
	12/01/2026	$67.23	$9.65	$19.00	$0.00	$95.88
For apprentice rates see "Apprentice- LABORER"						
TUNNEL WORK - FREE AIR *LABORERS (FREE AIR TUNNEL)*	12/01/2024	$51.25	$9.65	$19.00	$0.00	$79.90
	06/01/2025	$52.75	$9.65	$19.00	$0.00	$81.40
	12/01/2025	$54.25	$9.65	$19.00	$0.00	$82.90
	06/01/2026	$55.80	$9.65	$19.00	$0.00	$84.45
	12/01/2026	$57.30	$9.65	$19.00	$0.00	$85.95
For apprentice rates see "Apprentice- LABORER"						
TUNNEL WORK - FREE AIR (HAZ. WASTE) *LABORERS (FREE AIR TUNNEL)*	12/01/2024	$53.25	$9.65	$19.00	$0.00	$81.90
	06/01/2025	$54.75	$9.65	$19.00	$0.00	$83.40
	12/01/2025	$56.25	$9.65	$19.00	$0.00	$84.90
	06/01/2026	$57.80	$9.65	$19.00	$0.00	$86.45
	12/01/2026	$59.30	$9.65	$19.00	$0.00	$87.95
For apprentice rates see "Apprentice- LABORER"						
VAC-HAUL *TEAMSTERS JOINT COUNCIL NO. 10 ZONE B*	01/01/2025	$40.24	$15.57	$20.17	$0.00	$75.98
	06/01/2025	$41.24	$15.57	$20.17	$0.00	$76.98
	12/01/2025	$41.24	$15.57	$21.78	$0.00	$78.59
	01/01/2026	$41.24	$16.17	$21.78	$0.00	$79.19
	06/01/2026	$42.24	$16.17	$21.78	$0.00	$80.19
	12/01/2026	$42.24	$16.17	$23.52	$0.00	$81.93
	01/01/2027	$42.24	$16.77	$23.52	$0.00	$82.53

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
WAGON DRILL OPERATOR	12/01/2024	$40.61	$9.65	$17.70	$0.00	$67.96
LABORERS - ZONE 2	06/01/2025	$42.00	$9.65	$17.70	$0.00	$69.35
	12/01/2025	$43.38	$9.65	$17.70	$0.00	$70.73
	06/01/2026	$44.82	$9.65	$17.70	$0.00	$72.17
	12/01/2026	$46.26	$9.65	$17.70	$0.00	$73.61
	06/01/2027	$47.71	$9.65	$17.70	$0.00	$75.06
	12/01/2027	$49.16	$9.65	$17.70	$0.00	$76.51
	06/01/2028	$50.66	$9.65	$17.70	$0.00	$78.01
	12/01/2028	$52.16	$9.65	$17.70	$0.00	$79.51
For apprentice rates see "Apprentice- LABORER"						
WAGON DRILL OPERATOR (HEAVY & HIGHWAY)	12/01/2024	$40.11	$9.65	$17.80	$0.00	$67.56
LABORERS - ZONE 2 (HEAVY & HIGHWAY)	06/01/2025	$41.50	$9.65	$17.80	$0.00	$68.95
	12/01/2025	$42.88	$9.65	$17.80	$0.00	$70.33
	06/01/2026	$44.32	$9.65	$17.80	$0.00	$71.77
	12/01/2026	$45.76	$9.65	$17.80	$0.00	$73.21
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
WASTE WATER PUMP OPERATOR	12/01/2024	$57.03	$15.55	$16.50	$0.00	$89.08
OPERATING ENGINEERS LOCAL 4	06/01/2025	$58.33	$15.55	$16.50	$0.00	$90.38
	12/01/2025	$59.78	$15.55	$16.50	$0.00	$91.83
	06/01/2026	$61.08	$15.55	$16.50	$0.00	$93.13
	12/01/2026	$62.53	$15.55	$16.50	$0.00	$94.58
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
WATER METER INSTALLER	09/01/2024	$69.04	$14.32	$19.61	$0.00	$102.97
PLUMBERS & GASFITTERS LOCAL 12	03/02/2025	$70.84	$14.32	$19.61	$0.00	$104.77
For apprentice rates see "Apprentice- PLUMBER/PIPEFITTER" or "PLUMBER/GASFITTER"						

Additional Apprentice Information:

All apprentices must be registered with the Division of Apprenticeship Training (DAS) in accordance with M.G.L. c. 23, §§ 11E-11L. Minimum wage rates for apprentices employed on public works projects are listed above as a percentage of the hourly prevailing wage rate established by the Commissioner under the provisions of M.G.L. c. 149, §§ 26-27D. Apprentice ratios are established by DAS pursuant to M.G.L. c. 23, §§ 11E-11L. Ratios are expressed as the allowable number of apprentices to journeymen or fraction thereof, unless otherwise specified. The ratios listed herein have been taken from relevant private collective bargaining agreements (CBAs) and are provided for illustrative purposes only. They have not been independently verified as being accurate or continuing to be accurate. Parties having questions regarding what ratio to use should contact DAS.

SECTION 00 73 73

STATUTORY REQUIREMENTS

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract, EJCDC® C-700 (2007 Edition) included in Section 00 72 05. Provisions not so amended or supplemented remain in full force and effect unless amended or supplemented in another section. The terms used in this section have the meanings stated in the General Conditions. Additional terms used in this section, if any, have the meanings stated below which are applicable to both the singular and plural thereof. The address system used herein is the same as the address system used in the General Conditions, with the prefix "SC" added thereto.

This section includes certain provisions required by Laws and Regulations but does not represent or reflect all applicable provisions and policies or Laws and Regulations and may only include excerpts and portions thereof. Other required provisions and policies, and Laws and Regulations, shall be deemed to be so included and incorporated herein. Contractor is solely responsible to determine, obtain, review and interpret the full text of applicable provisions and policies, Regulations, and Laws.

The Project is specifically subject to the provisions of the Massachusetts General Laws ("MGL").

SC-1.01.A.15 *Contractor*

Add the following language at the end of the definition.

> Also referred to as "general Contractor" in applicable statutory provisions which may be used interchangeably and shall have the same meaning.

SC-1.01.A.29 *Owner*

Add the following language at the end of the definition.

> Also referred to as "*Awarding Authority*" or "*contracting authority*" in applicable statutory provisions which may be used interchangeably and shall have the same meaning.

SC-1.01.A.44 *Substantial Completion*

Add the following language at the end of the definition.

> For the purposes of MGL Chapter 30, Section 39G, *Completion of public works; semi-final and final estimates; payments*; *extra work; disputed items*, Substantial Completion shall also mean either that the Work has been completed except for Work having a valued at less than 1 percent of the then adjusted total Contract Price, or substantially all of the Work has been completed and opened to public use except for minor incomplete or unsatisfactory Work items that do not materially impair the usefulness of the Work as required by the Contract.

SC-1.01.B *Additional Terms*

Add the following new definition.

7. *material or Material* -- As used in MGL Chapter 30, Section 39M, *Contracts for construction and materials; manner of awarding,* regarding items equal to those specified, the word "material" shall mean and include any article, assembly, system, included in the Work, or any component part thereof.

SC-3 *CONTRACT DOCUMENTS: INTENT, AMEND, REUSE*

Add the following immediately after Paragraph 3.06.

3.07 *Public Records*

B. Pursuant to MGL Chapter 66 et seq, *Public Records*, related submittals, purchase orders, related pricing documents, and invoices will be public documents, and may be available for public and private distribution, except as specifically excluded. The Contractor will provide the Owner copies of any documents requested under this Law at no charge to the Owner or the requestor.

SC-4.03 *Differing Subsurface or Physical Conditions*

Delete Paragraph 4.03.B in its entirety and insert the following in its place.

B. Pursuant to MGL Chapter 30, Section 39N*, Construction contracts; equitable adjustment in contract price for differing subsurface or latent physical conditions*:

"If, during the progress of the Work, the Contractor or the Awarding Authority discovers that the actual subsurface or latent physical conditions encountered at the Site differ substantially or materially from those shown on the Plans or indicated in the Contract Documents either the Contractor or the contracting authority may request an equitable adjustment in the Contract Price of the Contract applying to Work affected by the differing Site conditions. A request for such an adjustment shall be in writing and shall be delivered by the party making such claim to the other party as soon as possible after such conditions are discovered. Upon receipt of such a claim from a Contractor, or upon its own initiative, the contracting authority shall make an investigation of such physical conditions, and, if they differ substantially or materially from those shown on the Plans or indicated in the Contract Documents or from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the Plans and Contract Documents and are of such a nature as to cause an increase or decrease in the cost of performance of the Work or a change in the construction methods required for the performance of the Work which results in an increase or decrease in the cost of the Work, the contracting authority shall make an equitable adjustment in the Contract Price and the Contract shall be modified in writing accordingly."

SC-5.01 ***Performance, Payment, and Other Bonds***

Add the following immediately after Paragraph 5.01.A.

1. Pursuant to MGL Chapter 30, Section 39A*, Construction contracts for public ways, airports or public works; truck rentals; security for payment,* and MGL Chapter 149, Section 29, *Bonds for payment for labor, materials, rentals or transportation charges (et al),* the required payment bond shall also cover payment by the Contractor and Subcontractors for the rental or hire of dump trucks and ". . .. the rental or hire of vehicles, steam shovels, rollers propelled by steam or other power, concrete mixers, tools and other appliances and equipment employed in such construction, . . ." and ". . . for payment of transportation charges directly related to such rental or hire. . ." Such security for payment of transportation charges shall be incorporated by appropriate reference thereto as an additional obligation or condition in the required bonds.

2. In addition, such bonds shall cover ". . . payment by Contractor and Subcontractors of any sums due trustees or other persons authorized to collect such payments from the Contractor or Subcontractors, for health and welfare plans, supplementary unemployment benefit plans and other fringe benefits which are payable in cash and provided for in collective bargaining agreements between organized labor and the Contractor or Subcontractors. . ."

SC-5.02 ***Licensed Sureties and Insurers***

Add the following immediately after Paragraph 5.02.A.

1. Pursuant to MGL Chapter 149, Section 29D, *Surety company; bonds:*

   "Every bid bond, every performance bond and every payment bond issued for any construction work in the commonwealth shall be the bond of a surety company organized pursuant to section 105 of chapter 175 or of a surety company authorized to do business in the commonwealth under the provisions of section 106 of said chapter 175 and be approved by the U.S. Department of Treasury and are acceptable as sureties and reinsurers on federal bonds under Title 31 of the United States Code, sections 9304 to 9308. "

2. If there is more than one surety company, the surety companies shall be jointly and severally liable.

SC-5.04 ***Contractor's Insurance***

Add the following language at the end of subparagraph 5.04.A.1.

, pursuant to MGL Chapter 149, Section 34A, *Contracts for public works; workers' compensation insurance; breach of contract; enforcement and violation of statute:*

"Every Contract for the construction, alteration, maintenance, repair or demolition of, or addition to, any public building or other public works for the commonwealth or any political subdivision thereof shall contain stipulations requiring that the Contractor shall, before commencing performance of such Contract, provide by insurance for the payment of compensation and the furnishing of other benefits under chapter one hundred and fifty-two to all persons to be employed under the Contract, and that the Contractor shall continue such insurance in full force and effect during the term of the Contract. No officer or agent contracting in behalf of the commonwealth or any political subdivision thereof shall award such a Contract until he has been furnished with sufficient proof of compliance with the aforesaid stipulations. Failure to provide and continue in force such insurance as aforesaid shall be deemed a material breach of the Contract and shall operate as an immediate termination thereof. No cancellation of such insurance, whether by the insurer or by the insured, shall be valid unless written notice thereof is given by the party proposing cancellation to the other party and to the officer or agent who awarded the Contract at least fifteen days prior to the intended effective date thereof, which date shall be expressed in said notice. Notice of cancellation sent by the party proposing cancellation by registered mail, postage prepaid, with a return receipt of the addressee requested, shall be a sufficient notice. An affidavit of any officer, agent or employee of the insurer or of the insured, as the case may be, duly authorized for the purpose, that he has so sent such notice addressed as aforesaid shall be prima facie evidence of the sending thereof as aforesaid. This section shall apply to the legal representative, trustee in bankruptcy, receiver, assignee, trustee and the successor in interest of any such Contractor. The superior court shall have jurisdiction in equity to enforce this section.

"Whoever violates any provision of this section shall be punished by a fine of not more than one hundred dollars or by imprisonment for six months, or both; and, in addition, any contractor who violates any provision of this section shall be prohibited from contracting, directly or indirectly, with the commonwealth or any political subdivision thereof, for the construction, alteration, demolition, maintenance or repair of, or addition to, any public works or public building for a period of two years from the date of conviction of said violation."

Delete the words "materially changed" per Massachusetts insurance Laws in subparagraph 5.04.B.4. line 2.

Add the following language at the end of subparagraph 5.04.C.1,

, in compliance with MGL Chapter 152

SC-5.06 *Property Insurance*

Delete the words "or materially changed" per Massachusetts insurance Laws in Paragraph 5.04.C. line 3.

SC-6.02 *Labor; Working Hours*

Add the following immediately after Paragraph 6.02.A.

1. Pursuant to MGL Chapter 30, Section 39S, *Contracts for construction; requirements***,** Contractor shall furnish labor that can work in harmony with all other elements of labor employed or to be employed in the Work.

2. Pursuant to MGL Chapter 149, Section 26*, Public works; preference to veterans and citizens; wages,* preference shall be given to citizens of the Commonwealth of Massachusetts, citizens of the town or city where the Project is located, veterans and service-disabled veterans, and citizens of the United States.

3. The Contractor shall comply with the provisions of MGL Chapter 151B, *Unlawful Discrimination Because of Race, Color, Religious Creed, National Origin, Ancestry or Sex.*

4. The Contractor shall not participate in or cooperate with an international boycott, as defined in Section 999 (b)(3) and (4) of the Internal Revenue Code as amended, or engage in conduct declared to be unlawful by MGL Chapter 151E, *Prohibition Of Certain Discrimination By Businesses, Section 2.*

Add the following immediately after Paragraph 6.02.B.

1. Pursuant to MGL Chapter 149, Section 30, *Eight hour day and six day week; emergencies; work on highways,* and Section 34*, Public contracts; stipulation as to hours and days of work; void contracts*:

   "Every contract, except for the purchase of material or supplies, involving the employment of laborers, workmen, mechanics, foremen or inspectors, to which the commonwealth or any county or any town, subject to section thirty, is a party, shall contain a stipulation that no laborer, workman, mechanic, foreman or inspector working within the commonwealth, in the employ of the contractor, sub-contractor or other person doing or contracting to do the whole or a part of the work contemplated by the contract, shall be required or permitted to work more than eight hours in any one day or more than forty-eight hours in any one week, or more than six days in any one week, except in cases of emergency, or, in case any town subject to section thirty-one is a party to such a contract, more than eight hours in any one day, except as aforesaid; provided, that in contracts entered

into by the department of highways for the construction or reconstruction of highways there may be inserted in said stipulation a provision that said department, or any contractor or sub-contractor for said department, may employ laborers, workmen, mechanics, foremen and inspectors for more than eight hours in any one day in such construction or reconstruction when, in the opinion of the commissioner, public necessity so requires. Every such contract not containing the aforesaid stipulation shall be null and void."

SC-6.05 ***Substitutes and "Or-Equals"***

Add the following language at the end of Paragraph 6.05.A.

The provisions of MGL Chapter 30, Section 39M, subsection (b) also apply to this Paragraph.

SC-6.09 ***Laws and Regulations***

Add the following immediately after Paragraph 6.09.A

1. MGL Chapter 260, Section 2B *Tort Actions Arising from Improvements to Real Property* shall apply.

SC-6.10 ***Taxes***

Add the following immediately after Paragraph 6.10.A.

1. MGL Chapter 64H, Section 6*, Exemptions,* subsection (f), exempts from Massachusetts sales tax, building materials and supplies to be used in the Project, and Contractor shall not include any amount therefor. The words "building materials and supplies" shall include all materials and supplies consumed, employed or expended in the construction, reconstruction, alteration, remodeling or repair of any building, structure, public highway, bridge, or other such public work, as well as such materials and supplies physically incorporated therein. Said words shall also include rental charges for construction vehicles, equipment and machinery rented specifically for use on the Project Site, or while being used exclusively for the transportation of materials for the Project.

SC-6.12 ***Record Documents***

Add the following immediately after Paragraph 6.12.A.

B. Subject to the provisions of MGL Chapter 266, Section 67C, *Capital facility construction projects, etc.; false entries in records; penalties,* and pursuant to MGL Chapter 30, Section 39R*, Keeping and maintaining books, records, and accounts; statement of management on internal accounting control; financial statements; enforcement:*

"(b). . .(1) The Contractor shall make, and keep for at least six years after final payment, books, records, and accounts which in reasonable detail accurately and fairly reflect the transactions and dispositions of the Contractor, and

"(2) until the expiration of six years after final payment, the office of inspector general, and the commissioner of capital asset management and maintenance shall have the right to examine any books, documents, papers or records of the Contractor or of his Subcontractors that directly pertain to, and involve transactions relating to, the Contractor or his Subcontractors, and

"(3) if the agreement is a contract as defined herein, the Contractor shall describe any change in the method of maintaining records or recording transactions which materially affect any statements filed with the Awarding Authority, including in his description the date of the change and reasons therefor, and shall accompany said description with a letter from the Contractor's independent certified public accountant approving or otherwise commenting on the changes, and

"(4) if the agreement is a contract as defined herein, the Contractor has filed a statement of management on internal accounting controls as set forth in paragraph (c) below prior to the execution of the contract, and

"(5) if the agreement is a contract as defined herein, the Contractor has filed prior to the execution of the contracts and will continue to file annually, an audited financial statement for the most recent completed fiscal year as set forth in paragraph (d) below.

"(c) Every Contractor awarded a contract shall file with the Awarding Authority a statement of management as to whether the system of internal accounting controls of the Contractor and its subsidiaries reasonably assures that:

"(1) transactions are executed in accordance with management's general and specific authorization;

"(2) transactions are recorded as necessary

i. to permit preparation of financial statements in conformity with generally accepted accounting principles, and

ii. to maintain accountability for assets;

"(3) access to assets is permitted only in accordance with management's general or specific authorization; and

"(4) the recorded accountability for assets is compared with the existing assets at reasonable intervals and appropriate action was taken with respect to any difference. Every Contractor awarded a contract shall also file with the Awarding Authority a statement prepared and signed by an independent certified public accountant, stating that he has examined the statement of management on internal accounting controls, and expressing an opinion as to (1) whether the representations of management in response to this paragraph and paragraph (b) above are consistent with the result of management's evaluation of the system of internal accounting controls; and (2) whether such representations of management are, in addition, reasonable with respect to transactions and assets in amounts which would be material when measured in relation to the applicant's financial statements.

"(d) Every Contractor awarded a contract by the commonwealth or by any political subdivision thereof shall annually file with the commissioner of capital asset management and maintenance during the term of the contract a financial statement prepared by an independent certified public accountant on the basis of an audit by such accountant. The final statement filed shall include the date of final payment. All statements shall be accompanied by an accountant's report. Such statements shall be made available to the Awarding Authority upon request.

"(e) . . . A Contractor's failure to satisfy any of the requirements of this section may be grounds for debarment pursuant to section forty-four C of chapter one hundred and forty-nine.

"(f) Records and statements required to be made, kept or filed under the provisions of this section shall not be public records as defined in section seven of chapter four and shall not be open to public inspection; provided, however, that such records and statements shall be made available pursuant to the provisions of clause (2) of paragraph (b)."

SC-6.13 ***Safety and Protection***

Add the following immediately after subparagraph 6.13.B.1. (added in Section 00 73 10).

2. Pursuant to *MGL Chapter 30, Section 39S*, all employees to be employed at the Work Site will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins Work, and who shall furnish documentation of successful completion of said course with the first certified payroll report for each employee. Any employee found on a Work Site subject to this section without documentation of successful completion of a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration shall be subject to immediate removal.

3. This Project is also subject to the following.

   - MGL Chapter 82, *The Laying Out, Alteration, Relocation and Discontinuance Of Public Ways, And Specific Repairs Thereon*, *Section 40*
     Section 40 Definitions
     Section 40A Excavations; notice
     Section 40B Designation of location of underground facilities
     Section 40C Excavator's responsibility to maintain designation markings; damage caused by excavator
     Section 40D Local laws requiring excavation permits; public ways
     Section 40E: Violations of Secs. 40A to 40E; punishment
   - MGL Chapter 82A, *Excavation and Trench Safety*
     Section 1 Unattended open trenches; safety hazards; rules and regulations; fines
     Section 2 Trench excavating permits; permits issued by board or officer; certificate of insurance; fees
     Section 3 Form of trench excavation permits; required statements
     Section 4 Definitions
     Section 5 Additional requirements
   - MGL Chapter 149
     Section 6C Health and safety of general public and asbestos workers; rules and regulations
     Section 129A Shoring Trenches for local governments
   - Massachusetts Department of Labor and Industries, Division of Occupational Safety (Chapter 454 CMR 10.00 et seq.)
   - Massachusetts Department of Public Safety "*Excavation and Trench Safety*" (Chapter 520 CMR 14.00 et seq.)

SC-6.20 *Indemnification*

Add the following immediately after subparagraph 6.20.C.3.

D. The provisions of MGL Chapter 258, *Claims and Indemnity Procedure for the Commonwealth, its Municipalities, Counties and Districts and the Officers and Employees Thereof* shall apply.

SC-8.09 *Limitations on Owner's Responsibilities*

Add the following immediately after Paragraph 8.09.A.

1. Pursuant to MGL Chapter 30, Section 39J *Public construction contracts; effect of decisions of contracting body or administrative board,* a decision on a dispute shall not be final or conclusive if such decision is made in bad faith, fraudulently, capriciously, or arbitrarily, is unsupported by substantial evidence, or is based upon error of law.

SC-9.08 ***Decisions on Requirements of Contract Documents and Acceptability of Work***

Replace "with reasonable promptness" with "within 30 days pursuant to MGL Chapter 30, Section 39P, *Contracts for construction and materials; awarding authority's decisions on interpretation of specifications, etc.; time limit; notice* in Paragraph 9.08.B.

Add the following new paragraph immediately after Paragraph 9.08.D.

E. Pursuant to MGL Chapter 30, Section 39J *Public construction contracts; effect of decisions of contracting body or administrative board,* a decision on a dispute shall not be final or conclusive if such decision is made in bad faith, fraudulently, capriciously, or arbitrarily, is unsupported by substantial evidence, or is based upon error of law.

SC-10.01 ***Authorized Changes in the Work***

Add the following immediately after Paragraph 10.01.A.

1. Changes to the Work are subject to the requirements of MGL Chapter 30, Section 39I, *Deviations from plans and specifications.*

SC-10.05 ***Claims***

Add the following immediately after Paragraph 10.05.G.

H. Presentation of false, fictitious, or fraudulent Claims is subject to the provisions of MGL Chapter 266, Section 67B, *Presentation of false claims*.

SC-11.01. ***Cost of the Work***

Add the following immediately after subparagraph 11.01.A.1.

a. Comply with prevailing wage requirements included in Section 00 73 43.

Add the following immediately after subparagraph 11.01.A.4.

a. Pursuant to MGL Chapter 149, Section 34B, *Contracts for public works; wages for reserve police officer,* the Contractor shall pay to any reserve police officer employed by him in any city or town, the prevailing rate of wage paid to regular police officers in such city or town.

Add the following immediately after subparagraph 11.01.A.5.d.

1) The Project is exempt from sales tax as set forth in SC-6.10.

SC-12.01 *Change of Contract Price*

Add the following immediately after subparagraph 12.01.B.3. as required by MGL Chapter 30, Section 38A *Price adjustment clause in contracts for road, bridge, water and sewer projects awarded.*

4. ***Monthly Price Adjustments for Certain Materials***: As required by Massachusetts Chapter 150 of the Acts of 2013, the following price adjustment clauses for fuel (both diesel and gasoline), liquid asphalt and Portland cement contained in cast-in-place concrete shall be applicable to the Project. The following Base Prices are established for the Project, based on period prices shown below as published by the Massachusetts Department of Transportation - Highway Division at

https://www.mass.gov/service-details/massdot-current-contract-price-adjustments

Liquid Asphalt - $560.00 per TON (January 2025)
Diesel - $2.694 per GALLON (December 2024)
Gasoline - $2.329 per GALLON (December 2024)
Portland Cement - $425.53 per TON (January 2025)

a. **Monthly Price Adjustment for Hot Mix Asphalt (HMA) Mixtures**: This adjustment will provide for either additional compensation to the Contractor or repayment to the Owner, depending on an increase or decrease in the Period Price of Liquid Asphalt.

1) Base Price: The Base Price of liquid asphalt listed above is the fixed price determined at the time of Bid by the Owner by using the same method as for the determination of the Period Price detailed below.

2) Price Adjustment: The Price Adjustment will be based on the variance in price for the liquid asphalt component only from the Base Price to the Period Price. It shall not include transportation or other charges. This Price Adjustment will occur on a monthly basis.

3) Period Price: The Period Price for this Contract shall be the Liquid Asphalt Period Price, per Ton.

4) Applicability: The Price Adjustment applies only to the actual virgin liquid asphalt content in the mixture placed on the Project in accordance with the Contract Documents.

5) Payment/Credit of Price Adjustment: The Contract Price of the hot mix asphalt mixture will be paid under the respective items in the Contract. The price adjustment, as herein

provided, upwards or downwards, will be made after the Work has been performed, using the monthly Period Price for the month during which the Work was performed. The Price Adjustment will be a separate payment item and processed by Change Order. It will be determined by multiplying the number of tons of hot mix asphalt mixtures placed within pay limits during each monthly period as shown on submitted certified weigh slips times the liquid asphalt content percentage times the variance in price between Base Price and Period Price of liquid asphalt. This Price Adjustment will be paid or credited if the variance from the Base Price is 5 percent or more for a monthly period. No further Price Adjustments will be processed after the Contract is finally complete, unless an extension of Contract Time is approved by the Owner.

b. **Monthly Price Adjustment for Diesel Fuel and Gasoline**: This adjustment will provide for either additional compensation to the Contractor or repayment to the Owner, depending on an increase or decrease in the Period Price of Diesel Fuel or Gasoline.

1) Base Price: The Base Price of Diesel Fuel and Gasoline listed above is the fixed price determined at the time of Bid by the Owner by using the same method as for the determination of the Period Price detailed below.

2) Price Adjustment: The Price Adjustment will be based on the variance in price from the Base Price to the Period Price.

3) Period Price: The Period Price for this Contract shall be the current Diesel Period Price and Gasoline Period Price per Gallon.

4) Applicability: The fuel Price Adjustment will apply only to the actual fuel used on the Project in accordance with the Contract Documents.

5) Payment/Credit of Price Adjustment: The Price Adjustment will be a separate payment item and processed by Change Order. The price adjustment, as herein provided, upwards or downwards, will be made after the Work has been performed, using the monthly Period Price for the month during which the Work was performed. This Price Adjustment will be paid or credited if the variance from the Base Price is 5 percent or more for a monthly period. No further Price Adjustments will be processed after the Contract is finally complete, unless an extension of Contract Time is approved by the Owner.

c. **Monthly Price Adjustment for Portland Cement Concrete Mixes**: This adjustment will provide for either additional compensation to the Contractor or repayment to the Owner, depending on an increase or decrease in the Period Price of Portland cement.

1) Base Price: The Base Price of Portland cement listed above is the fixed price determined at the time of Bid by the Owner by using the same method as for the determination of the Period Price detailed below.

2) Price Adjustment: The Price Adjustment will be based on the variance in price for the Portland cement component only from the Base Price to the Period Price. It shall not include transportation or other charges. This Price Adjustment will occur on a monthly basis.

3) Period Price: The Period Price for this Contract shall be the current Portland cement Period Price per Ton.

4) Applicability: The price adjustment applies only to the actual Portland cement content in the mix placed on the Project in accordance with the Contract Documents.

5) Payment/Credit of Price Adjustment: The Contract Price of the Portland cement content in the mix will be paid under the respective items in the Contract. The price adjustment, as herein provided, upwards or downwards, will be made after the Work has been performed, using the monthly Period Price for the month during which the Work was performed. The Price Adjustment will be a separate payment item and processed by Change Order. It will be determined by multiplying the number of cubic yards of Portland cement concrete placed during each monthly period times the Portland cement content percentage times the variance in price between the Base Price and Period Price of Portland cement. This Price Adjustment will be paid or credited if the variance from the Base Price is 5 percent or more for a monthly period. No further Price Adjustments will be processed after the Contract is finally complete, unless an extension of Contract Time is approved by the Owner.

SC-14.02. ***Progress Payments***

Add the following language to Paragraph 14.02.A.

The provisions of MGL Chapter 30, Section 39G*, Completion of public works; semi-final and final estimates; payments; extra work; disputed items*, covering "periodic estimate" and "periodic payment" apply to this Project and shall be considered Progress Payments per Paragraph 14.02. The forms listed in Section 00 60 00 and included in the Contract Documents will be utilized.

Add the following immediately after subparagraph 14.02.A.1.

a. Pursuant to MGL Chapter 30, Section 39S, *Contracts for construction; requirements***,** provide certification for each employee employed at the Work Site of successful completion of a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins Work.

Add the following immediately after subparagraph 14.02.D.3.

E. Pursuant to MGL Chapter 30, Section 39F, *Construction contracts; assignment and subrogation; subcontractor defined; enforcement of claim for direct payment; deposit, reduction of disputed amounts* regarding payment to Subcontractors, the following provisions shall be included in any subcontract in connection with Work under the Contract Documents.

"(a) Forthwith after the general Contractor receives payment on account of a periodic estimate, the general Contractor shall pay to each Subcontractor the amount paid for the labor performed and the materials furnished by that Subcontractor, less any amount specified in any court proceedings barring such payment and also less any amount claimed due from the Subcontractor by the general Contractor.

"(b) Not later than the 65th day after each Subcontractor substantially completes his Work in accordance with the Plans and Specifications, the entire balance due under the subcontract less amounts retained by the Awarding Authority as the estimated cost of completing the incomplete and unsatisfactory items of Work, shall be due the Subcontractor; and the Awarding Authority shall pay that amount to the general Contractor. The general Contractor shall forthwith pay to the Subcontractor the full amount received from the Awarding Authority less any amount specified in any court proceedings barring such payment and also less any amount claimed due from the Subcontractor by the general Contractor.

"(c) Each payment made by the Awarding Authority to the general Contractor pursuant to subparagraphs (a) and (b) above for the labor performed and the materials furnished by a Subcontractor shall be made to the general Contractor for the account of that Subcontractor; and the Awarding Authority shall take reasonable steps to compel the general Contractor to make each such payment to each such Subcontractor. If the Awarding Authority has received a demand for direct payment from a Subcontractor for any amount which has already been included in a payment to the general Contractor or which is to be included in a payment to the general Contractor for payment to the Subcontractor as provided in subparagraphs (a) and (b) above, the Awarding Authority shall act upon the demand as provided in this section of the MGL.

"(d) If, within seventy days after the Subcontractor has substantially completed the subcontract Work, the Subcontractor has not received from the general Contractor the balance due under the subcontract including any amount due for extra labor and materials furnished to the general Contractor, less any amount retained by the Awarding Authority as the estimated cost of completing the incomplete and unsatisfactory items of Work, the Subcontractor may demand direct payment of that balance from the Awarding Authority. The demand shall be by a sworn statement delivered to or sent by certified mail to the Awarding Authority, and a copy shall be delivered to or sent by certified mail to the general Contractor at the same time. The demand shall contain a detailed breakdown of the balance due under the subcontract and also a statement of the status of completion of the subcontract work. Any demand made after substantial completion of the subcontract work shall be valid even if delivered or mailed prior to the seventieth day after the Subcontractor has substantially completed the subcontract work. Within 10 days after the Subcontractor has delivered or so mailed the demand to the Awarding Authority and delivered or so mailed a copy to the general Contractor, the general Contractor may reply to the demand. The reply shall be by a sworn statement delivered to or sent by certified mail to the Awarding Authority and a copy shall be delivered to or sent by certified mail to the Subcontractor at the same time. The reply shall contain a detailed breakdown of the balance due under the subcontract including any amount due for extra labor and materials furnished to the general Contractor and of the amount due for each Claim made by the general Contractor against the Subcontractor.

"(e) Within fifteen days after receipt of the demand by the Awarding Authority, but in no event prior to the seventieth day after substantial completion of the subcontract work, the Awarding Authority shall make direct payment to the Subcontractor of the balance due under the subcontract including any amount due for extra labor and materials furnished to the general Contractor, less any amount (i) retained by the Awarding Authority as the estimated cost of completing the incomplete or unsatisfactory items of Work, (ii) specified in any court proceedings barring

such payment, or (iii) disputed by the general Contractor in the sworn reply; provided, that the Awarding Authority shall not deduct from a direct payment any amount as provided in part (iii) if the reply is not sworn to, or for which the sworn reply does not contain the detailed breakdown required by subparagraph (d). The Awarding Authority shall make further direct payments to the Subcontractor forthwith after the removal of the basis for deductions from direct payments made as provided in parts (i) and (ii) of this subparagraph.

"(f) The Awarding Authority shall forthwith deposit the amount deducted from a direct payment as provided in part (iii) of subparagraph (e) above in an interest-bearing joint account in the names of the general Contractor and the Subcontractor in a bank in Massachusetts selected by the Awarding Authority or agreed upon by the general Contractor and the Subcontractor and shall notify the general Contractor and the Subcontractor of the date of the deposit and the bank receiving the deposit. The bank shall pay the amount in the account, including accrued interest, as provided in an agreement between the general Contractor and the Subcontractor or as determined by decree of a court of competent jurisdiction.

"(g) All direct payments and all deductions from demands for direct payments deposited in an interest-bearing account or accounts in a bank pursuant to subparagraph (f) above shall be made out of amounts payable to the general Contractor at the time of receipt of a demand for direct payment from a Subcontractor and out of amounts which later become payable to the general Contractor and in the order of receipt of such demands from Subcontractors. All direct payments shall discharge the obligation of the Awarding Authority to the general Contractor to the extent of such payment.

"(h) The Awarding Authority shall deduct from payments to a general Contractor amounts which, together with the deposits in interest-bearing accounts pursuant to subparagraph (f) above, are sufficient to satisfy all unpaid balances of demands for direct payment received from Subcontractors. All such amounts shall be earmarked for such direct payments, and the Subcontractors shall have a right in such deductions prior to any Claims against such amounts by creditors of the general Contractor."

SC 14.04 *Substantial Completion*

Add the following immediately after Paragraph 14.04.E.

F. The provisions of MGL Chapter 30, Section 39G*, Completion of public works; semi-final and final estimates; payments; extra work; disputed items,* covering substantial completion apply to this Project. The forms listed in Section 00 60 00 and included in the Contract Documents will be utilized.

SC 14.07 *Final Payment*

Add the following immediately after subparagraph 14.07.A.1.

a. The provisions *of* MGL Chapter 30, Section 39G, *Completion of public works; semi-final and final estimates; payments; extra work; disputed items* covering the final estimate and completion of the Work apply to this Project. The forms listed in Section 00 60 00 and included in the Contract Documents will be utilized.

SC-15.01 *Owner May Suspend Work*

Add the following immediately after Paragraph 15.01.A.

1. Pursuant to MGL Chapter 30, Section 39O, *Contracts for construction and materials; suspension, delay or interruption due to order of awarding authority; adjustment in contract price; written claim*:

". . . (a) The Awarding Authority may order the general Contractor in writing to suspend, delay, or interrupt all or any part of the Work for such period of time as it may determine to be appropriate for the convenience of the Awarding Authority; provided however, that if there is a suspension, delay or interruption for 15 days or more or due to a failure of the Awarding Authority to act within the time specified in the Contract, the Awarding Authority shall make an adjustment in the Contract Price for any increase in the cost of performance of the Contract but shall not include any profit to the general Contractor on such increase; and provided further, that the Awarding Authority shall not make any adjustment in the Contract Price under this provision for any suspension, delay, interruption or failure to act to the extent that such is due to any cause for which this Contract provides for an equitable adjustment of the Contract Price under any other Contract provisions.

"(b) The general Contractor must submit the amount of a Claim under provision (a) above to the Awarding Authority in writing as soon as practicable after the end of the suspension, delay, interruption or failure to act and, in any event, not later than the date of final payment under the Contract and, except for costs due to a suspension order, the Awarding Authority shall not approve any costs in the Claim incurred more than 20 days before the general Contractor notified the Awarding Authority in writing of the act or failure to act involved in the Claim.

"In the event a suspension, delay, interruption or failure to act of the Awarding Authority increases the cost of performance to any Subcontractor, that Subcontractor shall have the same rights against the general Contractor for payment for an increase in the cost of his performance as provisions (a) and (b) above give the general Contractor against the Awarding Authority, but nothing in provisions (a) and (b) above shall in any way change, modify or alter any other rights which the general Contractor or the Subcontractor may have against each other."

SC-17.05 ***Controlling Law***

Add the following immediately after Paragraph 17.05.A.

1. This Contract is subject to all Laws and Regulations of the United States of America (including the U.S. Code of Federal Regulations), the Commonwealth of Massachusetts and other public authorities, and all amendments thereto. Where any requirements contained herein do not conform to or are inconsistent with such Laws and Regulations to which the Contract is subject or by which it is governed, such Laws and Regulations shall have precedence over any matters set forth herein.

2. The Project is specifically subject to MGL Chapters 30 and 149 for contracts awarded pursuant to MGL Chapter 30, Section 39M.

3. Statutes, Regulations, and portions and summaries thereof which are set forth or referred to in the Contract Documents shall be construed to include all amendments thereto in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids). The Owner and Engineer make no representation as to and assume no responsibility for the correctness or completeness of such statutory matters referred to or set forth herein.

4. Any provision in violation of the foregoing shall be deemed null, void and of no effect. Where conflicts with Laws and Regulations exist, the more stringent requirement shall apply.

END OF SECTION

SECTION 01 11 00

SUMMARY OF WORK

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Project Description

B. Description of the Work

C. Work Sequence and Coordination

D. Special Requirements

1.02 PROJECT DESCRIPTION

A. The Project is generally described as Devonshire Road Pump Station Improvements project and includes the replacement of two existing submersible pumps with chopper pumps; electrical upgrades including installation of phase-converting Variable Frequency Drives (VFDs), replacement of the backup generator, construction of new electrical enclosure and conduit; landscaping and restoration; bypass pumping; mechanical; electrical; and controls Work; and all materials and equipment, services and construction inherent to the Work.

1.03 DESCRIPTION OF THE WORK

A. The Work includes labor, material and equipment, services required for construction, testing, and commissioning of the Project in accordance with the Contract Documents and as more specifically described in the Specifications and Drawings and includes, but is not limited to, the following principal features.

1. Demolish the existing submersible pumps, pump slide rails, level floats, pump control panel, discharge piping, and associated appurtenances from the pump station wet well and electrical enclosure.

2. Furnish and install 2 submersible chopper pumps, phase-converting VFDs, pump control panel, slide rails, 4 level floats, and associated appurtenances.

3. Surface prep and paint existing discharge piping to remain and shown in the Drawings. Replace existing discharge piping as shown in the Drawings.

4. Provide temporary sewage bypassing during pump station downtime.

5. Demolish the existing backup generator, ATS, electrical equipment enclosure and all associated appurtenances. Utility meter, utility meter base, and mission auto-dialer to be disconnected and reinstalled.

6. Coordinate with Mission Communications to configure and program the Owner's existing reinstalled Mission unit.

7. Furnish and install a new backup generator.

8. Furnish and install a new electrical enclosure, main distribution panelboard, automatic transfer switch (ATS), enclosed circuit breaker disconnect, intrinsically safe barrier panel (ISBP), enclosure lighting, enclosure GFCI receptacles, enclosure heating/ventilation fans, vendor pump control panel and associated appurtenances.

9. Provide concrete equipment pads for the electrical enclosure and proposed backup generator as shown in Drawings.

10. Provide a new vinyl privacy fence around the perimeter of the pump station. Remove existing brush and provide a new arborvitae screen around the perimeter of the fence as shown in the Drawings.

11. Provide all material and equipment, construction and services inherent to the Work.

B. Work Site locations: generally as shown on the Drawings.

C. Existing conditions and Site data: per the Drawings and Section 00 31 00

1.04 WORK SEQUENCE AND COORDINATION

A. Sequence

1. Sequence Work to minimize shutdowns and reflect sequencing in the construction schedule.

2. Sanitary sewer service shall be maintained throughout construction. Construction shall be scheduled to minimize the length of time temporary bypassing is required.

3. The existing generator shall not be demolished until the proposed generator is operational. The existing generator shall not be used as backup power for any proposed equipment. Backup power must always be available during construction.

B. Coordination

1. Obtain written approval of the Engineer for shutdowns. Notify Engineer a minimum of two weeks prior to any required shutdowns. Contractor shall coordinate with Owner to perform shutdowns.

2. Contractor shall be responsible for any wet well cleaning required to complete the Work including, but not limited to, removing and legally disposing of solids, rags, and grease.

3. Coordinate Work with the City and provide public notice, as required.

4. Maintain access to location for the Owner throughout the Project.

5. Coordinate police details as necessary when Work or equipment is obstructing normal traffic.

6. Coordinate with electric utility (National Grid) to provide required electrical work at pump station, if necessary.

1.05 SPECIAL REQUIREMENTS

A. Coordinate obtaining permits through the Department of Public Works Engineering Division, Cheryl Schofield, Permit Technician, 978-640-4440 x221.

B. Planting shall be performed in accordance with Section 32 90 00.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 01 15 20

MAINTAINING OPERATIONS

PART 1 – GENERAL

1.01 SUMMARY

A. The Devonshire Road Pump Station is operated 24 hours a day, 7 days per week and must be maintained in continuous operation by the Owner at all time during the entire construction period.

1. Schedule and conduct Work to avoid impeding pumping operations or creating potential hazards to operating equipment and/or personnel.

2. Ensure construction schedule is compatible with the station operations.

B. Related Requirements

1. Section 01 50 00 – Temporary Facilities and Controls

2. Section 01 57 31 – Temporary Sewage Bypass

3. Section 01 91 15 – Startup and Commissioning

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

1.04 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Develop a sequence of operation, in cooperation with the Engineer and Owner, which shall provide for the orderly construction and start-up of the new equipment and upgrades. Within 30 calendar days of the Notice to Proceed, submit complete descriptions of procedures to maintain station operations to supplement the construction schedule, including the following.

1. Step-by-step procedures, required durations, and specific procedures required to be performed by the Contractor as well as assistance from the Owner's personnel that the Contractor will request. Include a minimum 2-week notification to the Owner for any alterations that affect the operation of the pumping station. Coordinate with the Owner again 7 days before and on the day of such alterations.

2. Complete plans of temporary systems required to maintain operations clearly delineating the intended location of these items and the proposed methods for phasing from existing to temporary to completed station operation. There temporary facilities include, but are not limited to temporary bypass pumping and temporary power supplies.

1.05 EXISTING PUMP STATION OPERATIONS

A. Unless permitted in writing by the Owner and Engineer, the construction activities under this Contract shall not reduce the pumping capability of the pump station.

B. The Owner will continue to operate the pump station during the construction period. The Contractor shall be required to fully cooperate with the Owner, coordinate the construction and bypass schedule with the Owner and Engineer, and provide the necessary labor, equipment, and materials to prevent interruption to flow.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

B. Unless permitted in writing by the Owner and Engineer, construction activities shall not reduce the capability of the pump station.

C. Owner will continue to operate the pump station during the construction period. Cooperate with the Owner, coordinate the construction and sewage bypassing schedule with the Owner and Engineer, and provide the necessary labor, equipment and materials to prevent interruption to sewer service.

PART 2 – (NOT USED)

PART 3 – EXECUTION

3.01 SEQUENCING AND COORDINATION WITH OPERATIONS

A. Sequence Work to achieve Project objectives and maintain pumping operations. Refer to Section 01 11 00 for detailed sequencing and coordination requirements.

B. Work shall be sequenced to minimize pump station downtime and the time needed for temporary sewage bypass.

C. Before starting Work which will interfere with the operation of existing facilities, conduct preparatory Work and ensure labor, tools, materials, and equipment are made ready. Assist in instructing operations and maintenance personnel in any new operating procedures.

D. Provide, maintain, and operate all necessary temporary facilities.

1. Do not allow sanitary flow to the pump station to be interrupted. Contractor shall provide temporary facilities and controls such that backups do not occur in the upstream sanitary sewer.

2. Sequence Work and provide temporary facilities as required.

E. When Work requires that the station be shut down, execute Work expeditiously. Plan the Work, taking into consideration potential problems. Provide that spare pumps, pipe and fittings, and any other equipment are readily available for use in an emergency. Be prepared to Work continuously (24 hours per day, 7 days per week) during the time when any units or pipelines are out of service that affect the treatment process.

F. Maintain road access to all areas of the Site at all times including sludge and residuals hauling and chemical delivery areas or as directed by Owner.

END OF SECTION

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SECTION 01 15 30

PAYMENT AND ADMINISTRATIVE PROCEDURES AND QUALITY REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. This Section specifies administrative and procedural requirements relating to payment, the process of contract administration, and the methods of communicating, controlling, and assuring quality. This Section applies to all Specifications and Drawings.

B. Certain provisions required by Laws and Regulations may be referenced. Contractor is responsible to determine and obtain applicable Laws and Regulations and to review and interpret the full text of such Laws and Regulations.

C. Section Includes

1.02 PAYMENT PROCEDURES
Schedule of Values
Payment Procedures
Change Procedures
Measurement and Payment Procedures
Correlation of Submittals

1.03 ADMINISTRATIVE REQUIREMENTS
Project Management and Coordination; Meetings
Documentation of Progress
Submittal Procedures

1.04 QUALITY REQUIREMENTS
Reference Standards and Regulatory Requirements

1.02 PAYMENT PROCEDURES

A. Schedule of Values: in accordance with Article 2 of the Standard General and Supplementary Conditions, if any.

1. Number of hardcopies: **0**

2. Submit electronically by email in PDF format.

3. Provide sufficient detail to allow for determination of the value of the Work at any degree of completion.

4. For each line item, identify number and title of Specification section in accordance with the Table of Contents.

B. Payment Procedures**:** in accordance with Article 14 of Standard General and Supplementary Conditions, if any.

1. Submit Application for Payment using the form included in the Project Forms section. Utilize latest approved Schedule of Values for listing items in Application for Payment. Provide supporting documentation for items included in the Application for Payment.

   a. Number of hardcopies: 0

   b. Submit electronically by email in PDF format.

2. Payment Period: at intervals stipulated in the Agreement.

3. Submit an updated Progress Schedule with each Application for Payment.

4. Police Details

   a. Provide daily detail slips for police details and proof of payment for invoices from the Town of Tewksbury Police Department with applications for payment.

   b. Payments shall only be made for standard 8-hour weekday police shifts for uniformed traffic police only.

   c. Do not include administrative fees.

   d. Overtime, premium, weekend and holiday rates shall be borne by the Contractor without reimbursement from the Owner unless specifically authorized in writing in advance.

C. Change Procedures: in accordance with Articles 10 and 12 of Standard General and Supplementary Conditions, if any, utilizing forms included in Section 00 60 00 Project Forms.

Number of hardcopies: 0

Submit electronically by email in PDF format.

1. Field Order: as authorized by Paragraph 9.04 of the Standard General and Supplementary Conditions, if any.

2. Change Request: issued by Engineer, Owner or Contractor to request or authorize minor variations and deviations, amendments or supplements to the Contract Documents. Initiate requests for substitute items per Paragraph 6.05 of the Standard General and Supplementary Conditions, if any, using a Change Request.

a. Include a detailed description of a proposed change with supplementary or revised Drawings and Specifications, including a change in Contract Times related to the change (with a stipulation for any overtime work required) and the period of time during which the requested price (if any) will be considered valid. Prepare and submit an estimate within 15 days.

b. Describe the proposed change and its full effect on the Work. Describe the reason for the change and the effect on the Contract Price and Contract Time with full documentation (and a statement describing the effect on Work by separate or other contractors).

3. Work Change Directive: as defined in subparagraph 1.01.A.51 of the Standard General and Supplementary Conditions, if any.

4. Change Order: in accordance with Articles 10 and 12 of the Standard General and Supplementary Conditions, if any.

a. *Stipulated Price Change Order*: based on Contractor's maximum price quotation or Contractor's request for a Change Order as approved by Engineer or Owner.

b. *Unit Price Change Order*: for pre-determined unit prices and quantities and executed on a fixed unit price basis. Execute Work under a Work Change Directive for unit costs or quantities of Work not pre-determined. Changes in Contract Price and Contract Time to be computed as specified for Time and Material Change Order.

c. *Time and Material Change Order*: based on itemized account and supporting data after completion of change within time limits indicated in the Standard General and Supplementary Conditions, if any. Engineer or Owner and Contractor to determine the change allowable in Contract Price and Contract Time as provided in the Standard General and Supplementary Conditions, if any. Maintain detailed records of Work completed on this basis, provide full information for evaluation of proposed changes, and substantiate costs for changes in the Work.

5. "Or Equals" and Substitutes: Request "Or-Equal" and substitute items as a Change Request per subparagraph 1.02.C.2 above, with complete data substantiating compliance with Contract Documents.

a. Or-Equal" and substitute items will be processed in accordance with Paragraph 6.05 of the Standard General and Supplementary Conditions, if any, and subparagraph 1.03.C.6 below.

D. Measurement and Payment Procedures

1. Payment includes full compensation for required labor, material and equipment, tools, plant, transportation, services and incidentals; erection, application or installation and construction of an item of the Work; and overhead and profit, unless otherwise indicated.

E. Correlation of Submittals

1. Promptly revise Schedule of Values and Applications for Payment to record each authorized Change Order as a separate line item and adjust the Contract Price.

2. Promptly revise Progress Schedule to reflect any change in Contract Times and revise sub-schedules to adjust time for other items of the Work affected by the change.

3. Promptly enter changes in Project record documents.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Project Management and Coordination; Meetings

1. Contact information for Owner and other entities related to the Project and special coordination requirements and contacts during prosecution of the Work will be provided at the Preconstruction Conference and Site Mobilization Meeting.

2. Inform Owner and Engineer of the address for sending official correspondence and the address and telephone number of Contractor's representative who will be project manager and Site superintendent for the Contract.

3. During periods of construction and testing keep Owner and Engineer informed in writing with name, address, and telephone number of Contractor's representative who will be responsible and available outside of normal working hours for emergency repairs and the maintenance of safety devices.

4. Identify the 24 hour, 7 days per week emergency response telephone or cell phone number that is staffed by a person (not a passive answering machine) or provide that a phone call will be returned within one hour.

5. Identify correspondence, submittals, drawings, data and materials, packing slips or other items associated with this Contract as follows.

6. Coordinate scheduling, submittals, and Work of the various Specifications to effectuate an efficient and orderly sequence for installing interdependent construction elements, with provisions for accommodating items installed later.

7. Preconstruction Conference and Site Mobilization Meeting

   a. Owner to schedule an initial preconstruction conference in accordance with Paragraph 2.06 of the Standard General and Supplementary Conditions, if any.

   b. Attendance required by Owner, Contractor, Engineer, Contractor's Superintendent, Project Manager, and Subcontractors as a minimum.

   c. Sample Agenda

      - Distribute Contract Documents
      - Discuss design concepts
      - Discuss preliminary Progress Schedule, Schedule of Submittals, Schedule of Values and preliminary cash flow projections.
      - Designate personnel representing each party; communication procedures
      - Procedures and processing of submittals, substitutions, applications for payments, Change Orders and Contract closeout procedures
      - Scheduling
      - Use of premises by Owner and Contractor
      - Owner's requirements and partial occupancy
      - Construction facilities and controls provided by Owner
      - Temporary utilities provided by Owner and Contractor
      - Survey and Site Layout
      - Security and housekeeping procedures
      - Schedules
      - Procedures for testing
      - Procedures for maintaining record documents
      - Requirements for startup
      - Inspection and acceptance of equipment put into service during construction period
      - Access, laydown and coordination with others

d. Engineer will record minutes and distribute draft copies promptly after meeting to Owner and Contractor for review, then revise as required and distribute thereafter to meeting participants, with copies to Owner and Contractor, and those affected by decisions made.

8. Progress Meetings

a. Owner to schedule progress meetings beginning no later than 60 days after the Initial Conference and continue thereafter on a monthly basis throughout progress of the Work.

b. Attendance required by Contractor, Contractor's Superintendent, major Subcontractors and Suppliers, Owner and Engineer as appropriate to agenda topics for each meeting.

c. Sample Agenda

- Review minutes of previous meetings – unresolved issues
- Overall project status
- Work Completed
- Anticipated Work
- Schedule
- Pay Applications
- Change Orders
- Submittals
- Observations, problems, and decisions
- General Discussion/Comments
- Action Items
- Date and time for next meeting

d. Engineer will record minutes and distribute draft copies promptly after meeting to Owner and Contractor for review, then revise as required and distribute thereafter to meeting participants, with copies to Owner and Contractor, and those affected by decisions made.

9. Pre-installation Conference and Coordination Meetings

a. When required, convene a pre-installation conference at Site before commencing certain Work that requires coordination or has special requirements or approval.

b. Convene coordination meetings as may be generally required.

c. Attendance required by parties directly affecting, or affected by, Work of the specific Specification section.

1) For pre-installation conference, notify Owner and Engineer 5 days in advance.

2) For coordination meetings, party requesting coordination meeting to notify other party(s).

d. Review conditions, preparation and procedures, and coordination with related Work.

B. Documentation of Progress

1. Submit preliminary and final Progress Schedules as specified in Paragraphs 2.05 and 2.07 of the Standard General and Supplementary Conditions, if any, or as established in Notice to Proceed.

Number of hardcopies: 0

Submit electronically by email in PDF format.

a. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration.

b. Indicate estimated percentage of completion for each item of Work at each submission.

c. Indicate dates for fabrication, factory testing, delivery, shipping and field testing, and material and equipment delivery dates, including those furnished by Owner. Coordinate with Schedule of Submittals.

2. Submit revised Progress Schedule on monthly basis and with each Application for Payment, identifying changes since previous version. Coordinate content with Schedule of Values, if any.

3. Documentation of Pre-Construction Conditions, Construction Progress, and Final Conditions

a. Documentation of Pre-Construction Conditions: not required for the Project.

b. Documentation of Construction Progress: not required for the Project.

c. Documentation of Final Conditions: not required for the Project.

4. Reports

a. Submit weekly Safety Reports signed by the Safety Representative.

C. Submittal Procedures

1. Schedule submittals to expedite the Project and coordinate with schedules required by Paragraph 1.03.B above. Deliver each submittal in the quantity and electronic form indicated to Engineer or Owner where required at the addresses specified below. Coordinate submission of related items.

   Engineer:

   Woodard & Curran
   Middlesex Corporate Center, 213 Court St., 4th Floor, Middletown, CT 06457
   Attn: Jacob Fortin
   Phone: 401-484-7928
   Email: jfortin@woodardcurran.com

2. Present submittals in a clear and thorough manner, in English and using English units. Provide space for Contractor, Engineer, and Owner's review stamps. Use sheet size of not less than 8 1/2 by 11 inches and not more than 24 by 36 inches.

3. Revise and resubmit documents as required. Identify all changes made since previous submittal. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions. Submittals not requested on the submittal schedule may not be recognized or processed.

4. Submit preliminary and final Schedule of Submittals as specified in Article 2 of the Standard General and Supplementary Conditions, if any, or as established in Notice to Proceed. Include all submittals specified in the Standard General and Supplementary Conditions, if any, General Requirements, and other Specification sections.

   Number of hardcopies: 0

   Submit electronically by email in PDF format.

   a. Include description of each submittal, date by which each submittal will be delivered to Engineer and Owner date by which each submittal must be approved to maintain project schedule, and relevant section reference.

   b. Allow 15-30 days from receipt of submittal/resubmittal for Engineer review of submittals and possible resubmittal.

5. Shop Drawings and Samples: Submit in accordance with Paragraph 6.17 of the Standard General and Supplementary Conditions, if any, and as follows, and coordinate with the Schedule of Submittals required in subparagraph 4 above.

   Number of hardcopies: 0

   Submit electronically by email in PDF format.

   a. Complete a Submittal Transmittal (Form 00 62 11) as is indicated, numbering each submittal consecutively. Assign resubmittals the same Transmittal number as the original with a suffix of a sequential letter to indicate the resubmittal (e.g. the first resubmittal of submittal 25 would be number 25A.) Include only those documents previously issued under original Submittal Transmittal number in resubmittals. Do not combine new submittals with resubmittals.

   b. Attach a Submittal Transmittal to each group of Shop Drawings, manufacturer's literature, equipment data and Samples submitted. Use a sufficient number of Submittal Transmittal forms so that: items on a single Submittal Transmittal form pertain to the same equipment item, Specification section or element of Work; items on a single Submittal Transmittal form are either original submittals or the same number resubmittal; and each Sample is listed on a separate Submittal Transmittal form.

   c. Submittals which do not have a fully completed Submittal Transmittal form will be returned along with unreviewed attachments. Returned submittals, even though incomplete, will be counted as a submittal.

   d. Submission of any Shop Drawing or Sample bearing Contractor's and Engineer's approval shall constitute a representation to Owner that the requirements of Paragraph 6.17 of the Standard General and Supplementary Conditions, if any, have been fulfilled.

   e. Engineer to complete review in accordance with Paragraph 6.17.D. of the Standard General and Supplementary Conditions, if any.

6. Variations: Identify variations from Contract Documents and material and equipment or system limitations which may be detrimental to successful performance of the completed Work and identify reasons therefor in accordance with subparagraph 6.17.C.3 of the Standard General and Supplementary Conditions, if any.

a. Clearly identify requests for "Or-Equal" and substitute items and submit per Paragraph 6.05 of Standard General and Supplementary Conditions, if any, and subparagraph 1.02.C.5 above. Substitute items will not be considered when indicated or implied on Shop Drawing or material and equipment data submittals without separate written request, or when acceptance will require revision to the Contract Documents.

7. Manufacturers' Installation Instructions and Certificates: Submit printed instructions for delivery, storage, assembly, installation, startup, adjusting, and finishing.

Number of hardcopies: 0

Submit electronically by email in PDF format.

a. Indicate special procedures, perimeter conditions requiring special attention and special environmental criteria required for application or installation.

b. Submit manufacturers' certificates for recent or previous test results on material or equipment, but they must be acceptable to Engineer and Owner. Indicate material or equipment conforms to or exceeds specified requirements and provide supporting reference date, affidavits, and certifications as appropriate.

c. Submit test results, data, and reports and certifications to Engineer based on tests performed. Submit test reports and certifications for independent testing services specified.

8. Record Documents and Closeout Submittals: submit in accordance with Paragraph 6.12 of the Standard General and Supplementary Conditions, if any.

a. Legibly mark each item to record description of actual equipment and material installed and actual construction on the Drawings and approved submittals, including the following.

1) Manufacturer's name and equipment and material model and number

2) Material and equipment substitutions or alternates utilized

3) Approved changes

4) Measured depths of foundations

5) Measured horizontal and vertical locations of Underground Facilities and appurtenances, referenced to permanent surface improvements

6) Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work

7) Field changes of dimension and detail

8) Details not on original Contract Documents or Shop Drawings

b. *As-Builts for Material and Equipment*

Number of prints: **0**

Electronic format: PDF (and DWG as available)

Submit electronically by email.

Indicate "As-Supplied" in revision block and sign. Show all changes and revisions to Final Completion. Include with Operation and Maintenance Data Part 2 below (if applicable).

c. *Drawings Conformed by Contractor to Construction Records*: Submit the following.

Number of prints: **0**

Electronic format: PDF (and DWG as available)

Submit electronically by email.

Indicate "Conformed by Contractor to Construction Records" in revision block and sign. Show all changes and revisions to Final Completion.

d. *Warranties and Guarantees*: Submit duplicate notarized copies of warranty documents which are executed and transferable from Subcontractors, Suppliers, and manufacturers. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance, listing date of acceptance as start of Warranty Period.

1) Submit in searchable PDF format by email.

2) Submit 0 copies in ring binders with durable plastic covers and table of contents.

e. *Operation and Maintenance Data (if applicable)*

1) Submit draft of completed volumes 30 days prior to equipment startup. Revise content of all sets as required prior to final submission.

Number of hardcopies: **0**

Submit in searchable PDF format by email.

2) Submit final volumes within 10 days after final inspection. Submit in searchable PDF format by email.

Submit 2 copies of data in ring binders with durable plastic covers with 8 1/2 by 11 inch text pages. Cover: title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of Project, and subject matter of binder when multiple binders are required.

3) Subdivide binder contents with permanent page dividers, logically organized as described below with laminated plastic tabs and clearly print the contents. Prepare a Table of Contents for each volume, with material, equipment, or system description identified, in three parts as follows.

Part 1: Directory, listing names, addresses, and telephone numbers of Contractor, Subcontractors, and major equipment Suppliers, and service representative.

Part 2: Operation and maintenance instructions arranged by system and subdivided by Specification section.

For each system, identify names, addresses, and telephone numbers of Subcontractors and Suppliers. Identify the following:

- Significant design criteria
- List of equipment with As-Builts certified "As-Supplied"
- Parts list for each component
- Operating instructions
- Inspection, maintenance and adjustment instructions for equipment and systems
- Lubrication and maintenance schedules
- Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents
- Troubleshooting guides
- Schematic diagrams

Part 3: Material Safety Data Sheets

Part 4: Other Project documents and certificates, including certificates and copies of warranties

1.04 QUALITY REQUIREMENTS

A. Reference Standards and Regulatory Requirements

1. Reference to standards, specifications, manuals or codes of any technical society, organization or association, or Laws or Regulations of any governmental authority are used in accordance with Paragraph 3.02 of the Standard General and Supplementary Conditions, if any.

2. Acronyms and abbreviations used are defined in the applicable versions of the Encyclopedia of Associations published by Gale (part of Cengage Learning) generally available in large libraries and on the internet.

3. Specific requirements applicable to the Project include the following.

a. The National Fire Protection Association (NFPA) 820 Standards for Fire Protection in Wastewater Treatment and Collection Facilities

Pump Station Space	NFPA 820 Classification and Reference
Wet Well	Class 1 Division 1 (C1D1), per Table 4.2 Row 16 Line a.
Dry Well, including Pump Room, Mezzanine, and Control Room	Unclassified, per Table 4.2 Row 17 Line a.
Electrical Cabinet	Unclassified

END OF SECTION

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SECTION 01 43 05

QUALIFICATION REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. Meet or provide capability to meet the criteria specified below and in individual Specification sections in connection with various portions of the Work of the Contract Documents.

1. See qualification requirements in the following sections.

Section 01 57 31 – Temporary Sewage Bypass

1.02 GENERAL REQUIREMENTS

A. Contractor shall have been regularly and actively engaged in similar Work as described in the Contract Documents, operating under the same business name and business organization structure, for the last 5 years on at least 5 projects.

B. Contractor shall have:

1. a full-time on-Site superintendent in responsible charge of the Work with at least 10 years' experience as superintendent on comparable projects;

2. a project manager assigned full-time (but not on Site full-time) with at least 10 years' experience as project manager on comparable projects; and

3. regularly engaged experienced engineers/design professionals licensed in the state the Project is located performing work similar to that specified.

C. Contractor shall have successfully completed at least 5 projects involving construction of similar facilities in the same region as the Project covered by the Contract Documents within the last 10 years. "Similar facilities" means similar in type, character, physical size, and complexity to that required by the Contract Documents.

1. successfully completed at least 5 projects with a total value in excess of $500,000 within the past 10 years.

END OF SECTION

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SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 – GENERAL

1.01 SUMMARY

A. This Section specifies temporary facilities and controls for execution of the Work put into place for use only during the period of construction, that will be removed when no longer required for construction operations. This Section applies to all Specifications and Drawings and provisions of this Section may be supplemented in other sections of Division 01.

B. Certain provisions required by Laws and Regulations may be referenced. Contractor is responsible to determine and obtain applicable Laws and Regulations and to review and interpret the full text of such Laws and Regulations.

C. Section Includes

1.02 TEMPORARY CONSTRUCTION FACILITIES
Barriers
Protection of Work
Security
Safety Facilities
Access Roads
Parking
Field Offices
Staging Area
Project Identification
Progress Cleaning and Waste Removal

1.03 TEMPORARY UTILITIES

1.04 TEMPORARY CONTROLS
Pest Control
Dust Control
Water Control and Dewatering
Erosion and Sediment Control
Noise Control
Pollution Control
Traffic Regulation

1.05 REMOVAL OF TEMPORARY UTILITIES, FACILITIES, AND CONTROLS

1.02 TEMPORARY CONSTRUCTION FACILITIES

A. Barriers

1. Comply with the requirements of Paragraph 6.11. of the Standard General Conditions and Supplementary Conditions, if any.

2. Furnish barriers to prevent unauthorized entry to and clear delineation of construction areas, to allow for Owner's use of Site, and to protect existing facilities and adjacent properties from damage from construction operations as recommended by OSHA and as otherwise required for the protection of life and property during construction.

3. Construct barricades and protective facilities in accordance with local and state regulations. Furnish and install signs, lights, reflectors, and such protection facilities as may be required.

4. Furnish barricades required by governing authorities for public rights of way.

5. Provide protection for plant life designated to remain. Replace damaged plant life.

6. Protect non owned vehicular traffic, stored materials, Site and structures from damage.

7. If required, furnish commercial grade, minimum 8 foot high chain link fence around construction Site. Equip with vehicular gates with locks.

B. Protection of Work

1. Protect Work during working and non-working hours.

2. Provide special protection where specified in Specifications or Drawings and in accordance with manufacturer recommendations.

3. Furnish temporary and removable protection for installed equipment and material. Control activity in immediate Work area to minimize damage.

4. Protect exterior areas of Work from damage. Prohibit traffic from landscaped areas.

5. Whenever gale or high winds are forecast, take measures to secure loose material, equipment or other items that could be blown and be damaged or cause damage. Do not leave such loose items unsecured at end of a working day. Particular attention shall be taken with scaffolding and items placed or stored on roofs or within a structure prior to being enclosed.

6. Provide for removal of snow and ice which may impede Work, damage the finishes or materials, be detrimental to workers, or impede trucking, delivery, or moving of materials at the Site, or prevent adequate drainage of the Site or adjoining areas.

C. Security

1. Provide protection to stored items, the Work and Owner's operations from unauthorized entry, vandalism, or theft, and against fire, storms and other losses during working and non-working hours.

2. Coordinate with Owner's security program.

D. Safety Facilities

1. Provide first aid and other safety facilities required by Laws and Regulations during working and non-working hours.

E. Access Roads

1. Extend and relocate as Work progress requires. Provide detours necessary for unimpeded traffic flow.

2. Provide for emergency access and maintain throughout the Work Site.

F. Parking:

1. Do not allow construction vehicle parking on existing pavement or sidewalks.

2. If additional parking is required, coordinate with Owner and Engineer for approved locations.

G. Field Offices: Not required for the Project.

H. Staging Area: None Provided

I. Project Identification: Not required for the Project.

J. Progress Cleaning and Waste Removal

1. Comply with the requirements of Paragraph 6.11.B and C of the Standard General Conditions and Supplementary Conditions, if any.

2. Maintain areas free of waste materials, debris, and rubbish and maintain the Site in a clean and orderly condition.

3. Remove debris and rubbish from spaces and other closed or remote spaces before enclosing the space.

4. Collect and remove waste materials, debris, and rubbish from Site at least weekly and legally dispose off-Site.

1.03 TEMPORARY UTILITIES

A. Power service: Not required for this Project

B. Telephone service and internet access to field offices: Not required for the Project.

C. Water service: Not required for the Project.

1.04 TEMPORARY CONTROLS

A. Pest Control: Provide methods, means, and facilities to control and prevent spread of pests during construction operations. If required, provide for extermination of pests in accordance with Laws and Regulations. For extensive infestations, obtain the services of a licensed exterminator and coordinate plan with Owner and Engineer.

B. Dust Control: Execute Work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere. Utilize the application of sprinkled water and calcium chloride as needed to reduce the emission of air-borne soil particulates from the Project Site.

1. Spread additional calcium chloride in response to complaints at no additional cost to Owner.

C. Water Control and Dewatering: as specified below.

1. Protect Site from puddling, ponding or running water.

D. Erosion and Sediment Control: as specified below.

1. Comply with:

a. MassDEP requirements

b. MassDOT requirements within State rights of way

c. Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas, prepared by the MassDEP

2. Plan and execute construction using methods to control surface drainage from cuts and fills, from borrow and waste disposal areas and prevent erosion and sedimentation.

3. Submit erosion and sediment control plan to Engineer prior to the start of construction.

4. Install erosion and sediment controls as required by Laws and Regulations. Install additional erosion and sedimentation control measures as necessary to stabilize the Site. Coordinate temporary erosion controls with permanent erosion controls to the extent practical. Provide and maintain devices to control erosion, siltation, and sedimentation that occur during construction operations. Undertake reasonable precautions and measures to avoid erosion of soil and to prevent silting of drainage ditches, storm sewers, rivers, streams, and lakes.

5. Employ pollution prevention measures, erosion and sedimentation control before, during, and after soils are exposed. Implement measures prior to soil disturbance or soil storage to the extent possible to ensure that such measures are in place before activity occurs and employ additional measures as the Work progresses. Implement and maintain as necessary until the Site is permanently stabilized.

6. Perform inspections of disturbed soil areas, material storage areas exposed to precipitation, and erosion control measures with Engineer a minimum of once every 14 days and also within 24 hours after any storm event greater than 0.5 inches of rainfall. Immediately correct deficiencies in the erosion control measures identified or indicated by failures or erosion by implementing additional measures or different techniques to correct and prevent subsequent erosion at no additional cost to Owner.

7. In the event that silt or debris breaches erosion control, immediately remove and clean silt or debris from drainage ditches and storm sewers and revise erosion control measures as required by the Conservation Commission or the Engineer. Should silt or debris breach erosion controls and reach rivers, streams or lakes, immediately notify local, state or Federal representatives as required and implement required remediation methods at no additional cost to Owner.

8. Limit duration of the exposure of soils on embankments, excavations, and graded areas to a minimum.

9. Provide temporary measures such as berms, dikes and drains to prevent water flow. Install erosion control measures in any ditch, swale or channel before water is allowed to flow in the waterway. Handle water pumped from trenches to minimize discharge of silty water to the maximum extent practicable.

10. Stabilize storm drain outfalls before the discharge points become operational. Install inlet protection immediately upon construction of culverts.

11. Stabilize disturbed areas with temporary and permanent erosion control practices as soon as practicable, but no more than 14 days after construction activity on a particular portion of the Site has temporarily or permanently ceased. Exceptions to this time requirement include: a) where construction activities will resume on the particular portion of the Site within 21 days; and b) where snow cover delays initiation of stabilization measures.

12. Place stockpiled topsoil on the Site away from natural drainages, in piles with side slopes of 50 percent to 70 percent. Install siltation fence around the base of the pile to prevent eroding soil from washing into drainages. Cover topsoil piles which are to remain for a period of 21 days or more with temporary seed and mulch immediately following stockpiling.

13. Conduct pavement sweeping to remove sediment and soil debris accumulation on pavement resulting from construction activity.

E. Noise Control

1. Provide methods, means, and facilities to minimize noise from construction operations.

2. Provide noise attenuation systems capable of meeting the federal and state Department of Environmental Protection Air Quality Control Regulations.

3. Construct sound enclosures or utilize other noise reduction techniques if the equipment does not meet the noise level requirements.

4. Submit a Noise Control plan for:

a. Night work: Not Permitted

b. Pumping operations and Work which extend beyond regular working hours.

c. Any other Work as determined by the Engineer which warrants special noise prevention measures.

F. Pollution Control: as specified below.

1. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.

a. Water Pollution Control

1) Ensure that sediment, debris, petroleum, chemicals, or other contaminants will not enter existing drainage facilities and channels. Use construction methods that will prevent entrance of pollutants and wastes into existing streams, rivers, lakes, and flowing and dry watercourses.

2) Obtain legal disposal sites and dispose of pollutants and wastes in a legal manner.

3) Respond immediately to emergencies as directed when water quality of existing streams, rivers, lakes and flowing and dry watercourses is threatened. Take corrective action to remove or contain pollutants until a permanent solution is determined.

b. Air Pollution Control

1) Equipment and vehicles that exhibit excessive exhausts emissions due to poor engine adjustments or inefficient operation will not be permitted to operate until corrective repairs or adjustments are made.

2) Burning of materials from clearing or grubbing operations, combustible construction materials, and rubbish will not be allowed.

G. Traffic Regulation: as specified below.

1. Submit traffic control plans and coordinate with Owner and local agencies. Submit plan for traffic control to Owner for review 14 days in advance of any Work within public right-of-way, street closure or detour.

2. Provide and maintain traffic control and maintenance devices in accordance with Part 6, Temporary Traffic Control, of the "Manual on Uniform Traffic Control Devices for Streets and Highways", published by the U.S. Department of Transportation, Federal Highway Administration and other applicable codes and standards as specified. Operate devices 24 hours per day as required.

a. Comply with applicable portions of the “Massachusetts Amendments to the 2009 Manual on Uniform Traffic Control Devices and the Standard Municipal Traffic Code” published by the Massachusetts Department of Transportation Highway Division.

b. Comply with relevant provisions of Section 7.00 of the MassDOT Standard Specifications and Supplements, and the following.

1) The intent of posting police details is to ensure public safety and protection of property through appropriate traffic control. Police personnel are not to be employed as watchmen to protect the Contractor's equipment and materials.

2) Submit a forecast weekly for traffic police detail schedule, at least 72 hours prior to the start of the Work describing: the nature and location of the Work, the number of police personnel, the estimated number of police hours required for each location, and justification for each uniformed officer being requested. Payment to the police for work under this Contract shall be in accordance with the Massachusetts General Laws, Chapter 149, Section 34B.

3) Scheduling of police details by Contractor shall be for standard 8-hour weekdays shifts and for uniformed police only. Police details for overtime, premium, weekend and holiday periods must be authorized in writing in advance. Inform the police department that the details are for a Town project and request administrative fees be omitted.

4) If uniformed police have been arranged to work, and weather or some other situation prohibits the Work, notify the Police Department a minimum of 2 hours before scheduled start time on the day of intended Work to cancel the work order. Unless the work order is canceled within 2 hours in advance, the Contractor shall incur the costs of police details that were not cancelled or cancelled without the proper 2-hour notification and shall be fully responsible for payment of all charges thus incurred.

3. Provide for access by emergency vehicles, such as police, fire, and disaster units at all times. Contractor shall be liable for damages resulting from failure to provide such access.

4. During construction hours, traffic flow must be controlled by uniformed traffic police officers or other traffic controllers allowed by Laws and Regulations. The services of traffic controllers shall in no way relieve the Contractor of its responsibilities under the Contract.

5. Coordinate schedule of police details directly with police department. Coordinate schedule of police details with Owner.

6. Maintain minimum of one moving lane on roadways at all times.

   a. Where detours are permitted, provide necessary barricades, flashers, flashing arrows and signs in accordance with referenced Manuals and Laws and Regulations.

b. Provide gravel borrow and bituminous concrete to maintain temporary passable travel lane ramps, temporary bridging, steel plates, temporary pavement, wood-framed walkways, caution, safety and other necessary signs directing the pedestrian and vehicular traffic towards unblocked and safe areas.

c. Except when road closure and road blockage permits are obtained, maintain two lanes of traffic (one in each direction) throughout construction and during non-working hours to the maximum extent possible.

7. Provide safe access/egress to businesses and abutting property owners within the Project area. In areas where the construction activity is in progress, provide directional signs in front of businesses indicating "OPEN FOR BUSINESS" or similar for guidance of customers.

a. Certain construction operations such as utility work and roadway/sidewalk reconstruction may restrict access/egress on some roads and to businesses and abutting property owners. Under these circumstances, schedule operations during off-peak hours or late evenings with Owner approval so that a particular work activity can be completed in the shortest possible time.

b. Provide 48 hours' notice to businesses and abutting property owners when access/egress will not be available or restrictions will exist.

8. Exercise particular care to establish and maintain such methods and procedures that will not create hazards.

a. Remove or properly cover traffic control, safety devices and/or signs having messages that are irrelevant to normal traffic conditions at the end of each Work period. Keep signs clean at all times and provide that legends are distinctive and unmarred.

b. Place excavated material and construction equipment so that vehicular and pedestrian traffic is maintained at all times unless road closure permit is obtained. If the Contractor's operations cause traffic hazards, implement appropriate safety measures immediately.

c. In areas of high pedestrian and vehicular traffic volume, the remove waste materials and construction equipment from the Work Site on a daily basis. Do not park construction equipment overnight on the Site or the adjacent roads unless permitted by Owner.

d. Provide night watchmen where special hazards exist.

9. Post signage clearly stating that any vehicle impeding the progress of construction will be towed at the vehicle owner's expense. Towing charges incurred by Owner for Contractor's failure to post such signs will be borne by the Contractor.

1.05 REMOVAL OF TEMPORARY UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, and facilities before Final Application for Payment inspection.

B. Remove temporary underground installations and grade Site as indicated. Clean and repair damage caused by installation or use of temporary utilities, facilities, and controls.

C. Restore existing facilities and areas used during construction to original condition. Restore permanent facilities used during construction to specified condition.

END OF SECTION

SECTION 01 57 31

TEMPORARY SEWAGE BYPASS

PART 1 – GENERAL

1.01 SUMMARY

A. Provide, operate, and maintain a functional bypass pumping system capable of bypassing each area of Work without leakage or spillage of sewage upon the ground or streets or back up of sewage into any building or onto any property for the duration of the Project.

B. Design Requirements:

1. Bypass pumping system shall operate continuously for the entire time between when the existing pumps are brought off-line and when new pumps are started up, tested, and brought into continuous service and both wet wells are returned to continuous service. It is anticipated that this time period will be 1-2 weeks. Design bypass pumping system to be robust and permanent enough for this duration. Provide a wetwell-to-forcemain or manhole-to-manhole setup(s) as required.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: in accordance with Division 01 General Requirements.

1.04 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

1. Bypass pumping plan for each bypass location, prior to implementation and prior to the start of construction, to be approved by Owner and Engineer.

2. Minimum contents of sewage bypass pumping plan:

a. Standard Operating Procedure: Describe the normal sequence of events to be followed while pumping and setting up and breaking down pumping equipment. Plan must address strategies and safeguards to ensure that public safety and environmental health is maintained at all times, the possibility of property damage and wetlands impacts, and overall level of inconvenience is minimized.

b. Layout drawing showing locations of equipment on Site and how access to the Site is maintained

c. Equipment lists

d. Pump curves and motor and engine data demonstrating equipment is sufficiently sized to meet all specified and anticipated operating conditions

e. Notification form

f. Emergency Response Plan: Describe the intended means of handling the following situations, including response and clean-up measures, and emergency backup power or backup fuel storage. List equipment to be used and where it will be stored.

- Break or failure of bypass line (pipe)
- Failure of bypass pump
- Overflow
- Back up into dwelling or onto private property
- Failure of bypass pumping system to accommodate flow

3. Shop Drawings for equipment and materials including, but not limited to:

- Pumps
- Engines and/or Motors
- Sound Enclosures
- Pipe or hose
- Joints/couplings
- Plugs and/or bladders

4. Statement of Qualifications demonstrating experience of the firm in accordance with Article 1.05 and listing a minimum of 10 successful bypass pumping projects conducted in the last ten years. Provide contact information for no fewer than 5 of these projects which:

- Have been completed in the last 5 years,
- Involved similar equipment to that proposed for this Project, and

1.05 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Qualifications: per Division 01 General Requirements and as follows.

1. Bypass pumping system shall be provided, operated, and maintained by a firm which has been regularly engaged in providing bypass pumping for a minimum of 10 years.

1.06 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

B. The Project area consists of active sanitary sewers into a wet well; therefore, flows and flow data are variable depending on location and conditions. Visit the Work locations prior to start of Work to visually inspect flow conditions as necessary.

1. The fluid to be pumped is raw sanitary wastewater which contains typical solids, rags, and debris. Flows are subject to typical diurnal variations and also increase significantly during wet weather and high groundwater. Provide that the bypass pumping system is capable of handling all of these conditions.

C. Portions of the Project are subjected to infiltration and inflow. Account for infiltration and inflow volume in the planning and conduct of the Work.

D. Pump station runtimes are provided at the end of this section for reference in preparing the basis of design for the bypass pumping plan. Contractor to size bypass pumping system to handle station flows.

PART 2 – PRODUCTS

2.01 BYPASS PUMPING SYSTEM

A. Godwin Pumps (a Xylem brand)

B. Griffin Dewatering

C. Rain for Rent

D. Or equal

2.02 PUMPS, PIPES & FITTINGS

A. Provide pumps suitable for use with raw, unscreened sewage and capable of conveying the volume of flow anticipated with a sufficient margin of safety. Provide for 100 percent redundancy (2 pumps the Site for every 1 pump required) if flow cannot be returned to the sewer at any time if pumping system failure occurs.

1. Redundant pumping: suction and discharge piping with quick connect couplings to facilitate change out of pumps.

B. Pump Connections: quick connect couplings to facilitate change out of pumps

C. Pipe: carbon steel, fused high-density polyethylene pipe, or equal.

D. Joints: Victaulic or approved equal.

E. Fittings: quick-connect type.

F. Lay-flat hose: extra heavy duty, highly abrasion resistant, fitted with gasketed couplings, and rated for 150 percent of working pressure.

G. Provide sound attenuation enclosure for engines and pumps in accordance with state and local noise requirements.

H. Control: automatic level control for pumps. Redundant pump shall start automatically if one duty pump fails.

I. Autodialers: provide autodialers with capacity to call up to 3 different phone numbers upon low fuel, pump failure, and high wetwell level.

PART 3 – EXECUTION

3.01 GENERAL

A. Maintain flows under all flow conditions. Adequately handle flows, even instantaneous peak flows, without damage or overflow, providing for potential large instantaneous flow contributors connected to the sewer under repair.

B. Allow for passage of traffic and protect bypass piping at driveway and street crossings.

C. Coordinate bypassing with low-flow times to the extent possible. Prevent overflows or backups.

D. If Contractor determines bypass pumping is not required at a location due to lack of flow or determines that a Work item does not require bypass pumping to be performed, and Engineer agrees, protect flows from construction debris and ensure no debris enters the sewer system.

E. Repair damage to existing pipes and structures to the satisfaction of the Engineer.

F. Prevent sanitary flow from discharging into salt or fresh water body by means of overflow, bypass pumping, or other methods.

G. Restore normal service to entire system at end of normal working hours each day.

3.02 SHUTDOWN

A. Shutdown of sewer service for residential area is not permitted. Maintain flow of wastewater at all times with no interruption of service for users upstream of the pump station.

3.03 TEMPORARY POWER

A. Provide fuel and power to run bypass pumps at no additional cost to Owner.

3.04 PIPING

A. Provide that piping system has adequate water tightness. Perform a leakage test with clean water at Engineer's direction, at no additional cost to Owner.

B. Lay temporary piping along the general lines of streets or roadways in a manner that causes the minimum amount of disruption and is least likely to be damaged. Use temporary bituminous pavement, cold patch, or other approved material to form a ramp on each side of the pipe or depress the pipe at driveways to allow for property owners to drive over the temporary pipe as directed by the Engineer.

3.05 OPERATION AND MAINTENANCE

A. Continuously monitor bypassing operations regardless of duration or timing of bypassing. Unattended bypass pumping is prohibited.

B. Arrange for bypass pumping past working hours with Engineer and provide adequate sound attenuation and an attendant.

C. Do not allow leaks in bypass pumping systems. Clean and disinfect leaks at no additional cost to Owner.

3.06 ATTACHMENTS

A. Pump Data

END OF SECTION

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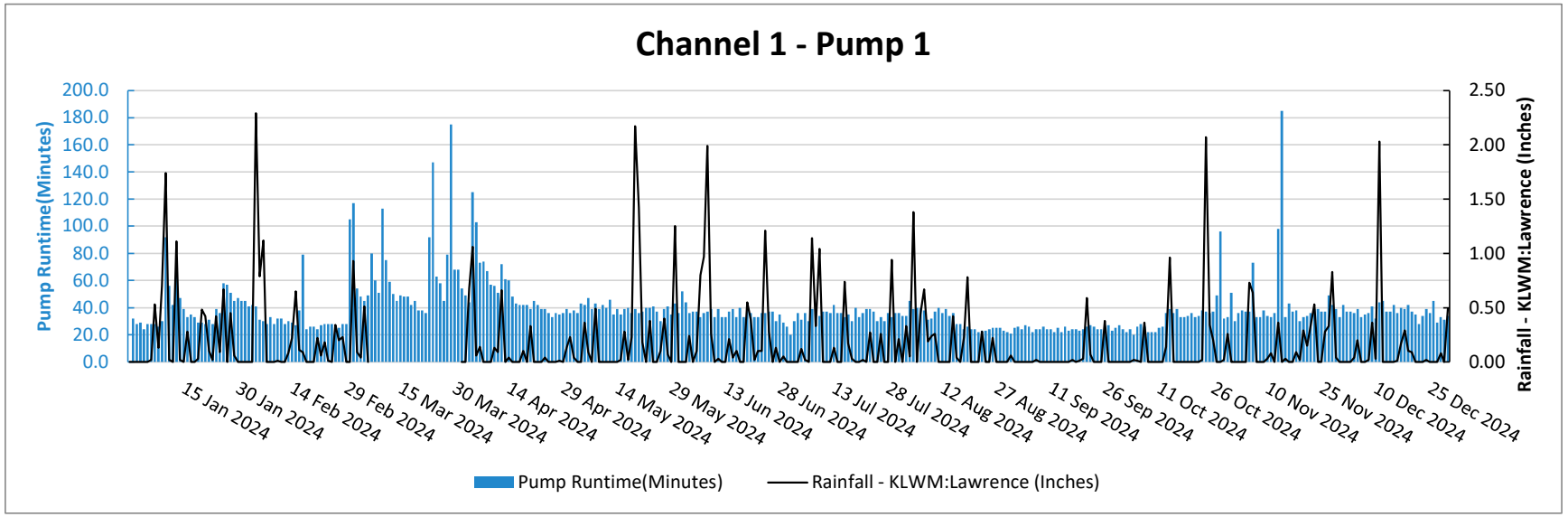
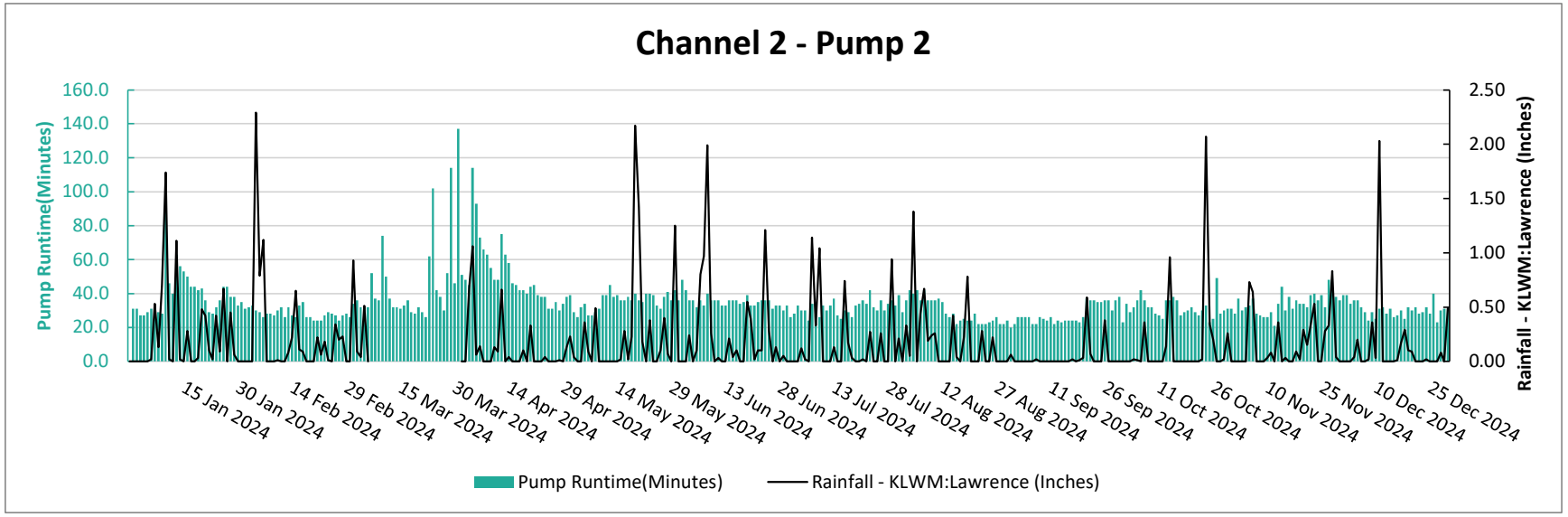
Section 01 57 31 Attachment:
Pump Station Runtime Data (January 2024 - December 2024)

Runtime Data (Daily)
Tewksbury DPW Water and Sewer - Devonshire Road P.S. (G)
1 Jan 2024 12 AM - 1 Jan 2025 12 AM





Runtime Data (Daily)
Tewksbury DPW Water and Sewer - Devonshire Road P.S. (G)
1 Jan 2024 12 AM - 1 Jan 2025 12 AM
(**NOTE:** Gallons field is hidden for Zero pump capacity)

Date/Time	Pump 1				Pump 2				Intrusion			Total			Rainfall (Inches)
	Starts	Runtime	Average	Gallons	Starts	Runtime	Average	Gallons	Starts	Runtime	Average	Starts	Runtime	Gallons	KLWM:Lawrence
1 Jan 2024	16	32.0	2.0	3,232	15	31.0	2.1	3,410	0	0.0	0.0	31	63.0	6,642	0.00
2 Jan 2024	14	28.0	2.0	2,828	15	31.0	2.1	3,410	0	0.0	0.0	29	59.0	6,238	0.00
3 Jan 2024	14	29.0	2.1	2,929	13	27.0	2.1	2,970	0	0.0	0.0	27	56.0	5,899	0.00
4 Jan 2024	12	24.0	2.0	2,424	13	27.0	2.1	2,970	0	0.0	0.0	25	51.0	5,394	0.00
5 Jan 2024	14	28.0	2.0	2,828	14	29.0	2.1	3,190	0	0.0	0.0	28	57.0	6,018	0.00
6 Jan 2024	14	28.0	2.0	2,828	14	31.0	2.2	3,410	0	0.0	0.0	28	59.0	6,238	0.02
7 Jan 2024	14	28.0	2.0	2,828	13	28.0	2.2	3,080	0	0.0	0.0	27	56.0	5,908	0.53
8 Jan 2024	13	26.0	2.0	2,626	14	29.0	2.1	3,190	0	0.0	0.0	27	55.0	5,816	0.13
9 Jan 2024	14	30.0	2.1	3,030	14	28.0	2.0	3,080	0	0.0	0.0	28	58.0	6,110	0.70
10 Jan 2024	36	92.0	2.6	9,292	36	95.0	2.6	10,450	0	0.0	0.0	72	187.0	19,742	1.74
11 Jan 2024	22	56.0	2.5	5,656	22	46.0	2.1	5,060	0	0.0	0.0	44	102.0	10,716	0.02
12 Jan 2024	19	42.0	2.2	4,242	18	40.0	2.2	4,400	0	0.0	0.0	37	82.0	8,642	0.00
13 Jan 2024	26	63.0	2.4	6,363	27	63.0	2.3	6,930	0	0.0	0.0	53	126.0	13,293	1.11
14 Jan 2024	22	47.0	2.1	4,747	22	56.0	2.5	6,160	0	0.0	0.0	44	103.0	10,907	0.02
15 Jan 2024	19	39.0	2.1	3,939	18	53.0	2.9	5,830	0	0.0	0.0	37	92.0	9,769	0.00
16 Jan 2024	16	33.0	2.1	3,333	17	50.0	2.9	5,500	0	0.0	0.0	33	83.0	8,833	0.28
17 Jan 2024	16	35.0	2.2	3,535	15	44.0	2.9	4,840	0	0.0	0.0	31	79.0	8,375	0.00
18 Jan 2024	15	33.0	2.2	3,333	15	44.0	2.9	4,840	0	0.0	0.0	30	77.0	8,173	0.00
19 Jan 2024	14	29.0	2.1	2,929	14	42.0	3.0	4,620	0	0.0	0.0	28	71.0	7,549	0.03
20 Jan 2024	14	29.0	2.1	2,929	15	43.0	2.9	4,730	0	0.0	0.0	29	72.0	7,659	0.48
21 Jan 2024	14	28.0	2.0	2,828	14	36.0	2.6	3,960	0	0.0	0.0	28	64.0	6,788	0.42
22 Jan 2024	14	31.0	2.2	3,131	13	29.0	2.2	3,190	0	0.0	0.0	27	60.0	6,321	0.10
23 Jan 2024	13	28.0	2.2	2,828	14	28.0	2.0	3,080	0	0.0	0.0	27	56.0	5,908	0.02
24 Jan 2024	17	39.0	2.3	3,939	16	32.0	2.0	3,520	0	0.0	0.0	33	71.0	7,459	0.42
25 Jan 2024	17	36.0	2.1	3,636	17	36.0	2.1	3,960	0	0.0	0.0	34	72.0	7,596	0.09
26 Jan 2024	21	58.0	2.8	5,858	21	44.0	2.1	4,840	0	0.0	0.0	42	102.0	10,698	0.67
27 Jan 2024	20	57.0	2.8	5,757	21	44.0	2.1	4,840	0	0.0	0.0	41	101.0	10,597	0.00
28 Jan 2024	20	51.0	2.6	5,151	19	38.0	2.0	4,180	0	0.0	0.0	39	89.0	9,331	0.45
29 Jan 2024	18	45.0	2.5	4,545	19	38.0	2.0	4,180	0	0.0	0.0	37	83.0	8,725	0.06
30 Jan 2024	17	47.0	2.8	4,747	16	33.0	2.1	3,630	0	0.0	0.0	33	80.0	8,377	0.00
31 Jan 2024	16	45.0	2.8	4,545	17	35.0	2.1	3,850	0	0.0	0.0	33	80.0	8,395	0.00
1 Feb 2024	16	45.0	2.8	4,545	15	31.0	2.1	3,410	0	0.0	0.0	31	76.0	7,955	0.00
2 Feb 2024	15	41.0	2.7	4,141	16	32.0	2.0	3,520	0	0.0	0.0	31	73.0	7,661	0.00
3 Feb 2024	16	42.0	2.6	4,242	16	33.0	2.1	3,630	0	0.0	0.0	32	75.0	7,872	0.00
4 Feb 2024	15	41.0	2.7	4,141	15	30.0	2.0	3,300	0	0.0	0.0	30	71.0	7,441	2.29
5 Feb 2024	14	31.0	2.2	3,131	14	29.0	2.1	3,190	0	0.0	0.0	28	60.0	6,321	0.79
6 Feb 2024	14	30.0	2.1	3,030	13	26.0	2.0	2,860	0	0.0	0.0	27	56.0	5,890	1.12
7 Feb 2024	13	28.0	2.2	2,828	14	28.0	2.0	3,080	0	0.0	0.0	27	56.0	5,908	0.00
8 Feb 2024	15	33.0	2.2	3,333	14	28.0	2.0	3,080	0	0.0	0.0	29	61.0	6,413	0.00

Runtime Data (Daily)
Tewksbury DPW Water and Sewer - Devonshire Road P.S. (G)
1 Jan 2024 12 AM - 1 Jan 2025 12 AM
(**NOTE:** Gallons field is hidden for Zero pump capacity)

Date/Time	Pump 1				Pump 2				Intrusion			Total			Rainfall (Inches)
	Starts	Runtime	Average	Gallons	Starts	Runtime	Average	Gallons	Starts	Runtime	Average	Starts	Runtime	Gallons	KLWM:Lawrence
9 Feb 2024	13	28.0	2.2	2,828	14	27.0	1.9	2,970	0	0.0	0.0	27	55.0	5,798	0.00
10 Feb 2024	15	32.0	2.1	3,232	14	30.0	2.1	3,300	0	0.0	0.0	29	62.0	6,532	0.01
11 Feb 2024	15	32.0	2.1	3,232	16	32.0	2.0	3,520	0	0.0	0.0	31	64.0	6,752	0.00
12 Feb 2024	14	28.0	2.0	2,828	13	26.0	2.0	2,860	0	0.0	0.0	27	54.0	5,688	0.00
13 Feb 2024	15	30.0	2.0	3,030	16	32.0	2.0	3,520	0	0.0	0.0	31	62.0	6,550	0.08
14 Feb 2024	14	29.0	2.1	2,929	13	27.0	2.1	2,970	0	0.0	0.0	27	56.0	5,899	0.22
15 Feb 2024	13	27.0	2.1	2,727	14	26.0	1.9	2,860	0	0.0	0.0	27	53.0	5,587	0.65
16 Feb 2024	17	38.0	2.2	3,838	16	33.0	2.1	3,630	0	0.0	0.0	33	71.0	7,468	0.11
17 Feb 2024	19	79.0	4.2	7,979	21	35.0	1.7	3,850	0	0.0	0.0	40	114.0	11,829	0.09
18 Feb 2024	12	24.0	2.0	2,424	13	26.0	2.0	2,860	0	0.0	0.0	25	50.0	5,284	0.00
19 Feb 2024	13	26.0	2.0	2,626	13	26.0	2.0	2,860	0	0.0	0.0	26	52.0	5,486	0.00
20 Feb 2024	13	26.0	2.0	2,626	12	24.0	2.0	2,640	0	0.0	0.0	25	50.0	5,266	0.00
21 Feb 2024	11	24.0	2.2	2,424	12	24.0	2.0	2,640	0	0.0	0.0	23	48.0	5,064	0.22
22 Feb 2024	12	27.0	2.2	2,727	12	24.0	2.0	2,640	0	0.0	0.0	24	51.0	5,367	0.06
23 Feb 2024	14	28.0	2.0	2,828	13	27.0	2.1	2,970	0	0.0	0.0	27	55.0	5,798	0.18
24 Feb 2024	14	28.0	2.0	2,828	14	29.0	2.1	3,190	0	0.0	0.0	28	57.0	6,018	0.01
25 Feb 2024	14	28.0	2.0	2,828	14	28.0	2.0	3,080	0	0.0	0.0	28	56.0	5,908	0.00
26 Feb 2024	12	24.0	2.0	2,424	13	27.0	2.1	2,970	0	0.0	0.0	25	51.0	5,394	0.34
27 Feb 2024	12	25.0	2.1	2,525	12	24.0	2.0	2,640	0	0.0	0.0	24	49.0	5,165	0.20
28 Feb 2024	14	28.0	2.0	2,828	13	27.0	2.1	2,970	0	0.0	0.0	27	55.0	5,798	0.23
29 Feb 2024	13	28.0	2.2	2,828	14	28.0	2.0	3,080	0	0.0	0.0	27	56.0	5,908	0.00
1 Mar 2024	18	105.0	5.8	10,605	18	26.0	1.4	2,860	0	0.0	0.0	36	131.0	13,465	0.00
2 Mar 2024	19	117.0	6.2	11,817	16	34.0	2.1	3,740	0	0.0	0.0	35	151.0	15,557	0.93
3 Mar 2024	18	54.0	3.0	5,454	18	36.0	2.0	3,960	0	0.0	0.0	36	90.0	9,414	0.09
4 Mar 2024	16	48.0	3.0	4,848	16	32.0	2.0	3,520	0	0.0	0.0	32	80.0	8,368	0.04
5 Mar 2024	15	45.0	3.0	4,545	15	30.0	2.0	3,300	0	0.0	0.0	30	75.0	7,845	0.51
6 Mar 2024	16	49.0	3.1	4,949	16	32.0	2.0	3,520	0	0.0	0.0	32	81.0	8,469	0.00
7 Mar 2024	25	80.0	3.2	8,080	25	52.0	2.1	5,720	0	0.0	0.0	50	132.0	13,800	
8 Mar 2024	19	60.0	3.2	6,060	18	37.0	2.1	4,070	0	0.0	0.0	37	97.0	10,130	
9 Mar 2024	17	51.0	3.0	5,151	18	36.0	2.0	3,960	0	0.0	0.0	35	87.0	9,111	
10 Mar 2024	32	113.0	3.5	11,413	32	74.0	2.3	8,140	0	0.0	0.0	64	187.0	19,553	
11 Mar 2024	24	75.0	3.1	7,575	24	50.0	2.1	5,500	0	0.0	0.0	48	125.0	13,075	
12 Mar 2024	19	59.0	3.1	5,959	18	37.0	2.1	4,070	0	0.0	0.0	37	96.0	10,029	
13 Mar 2024	16	50.0	3.1	5,050	16	32.0	2.0	3,520	0	0.0	0.0	32	82.0	8,570	
14 Mar 2024	15	45.0	3.0	4,545	16	32.0	2.0	3,520	0	0.0	0.0	31	77.0	8,065	
15 Mar 2024	16	49.0	3.1	4,949	15	31.0	2.1	3,410	0	0.0	0.0	31	80.0	8,359	
16 Mar 2024	15	48.0	3.2	4,848	16	33.0	2.1	3,630	0	0.0	0.0	31	81.0	8,478	
17 Mar 2024	16	48.0	3.0	4,848	16	36.0	2.2	3,960	0	0.0	0.0	32	84.0	8,808	
18 Mar 2024	14	42.0	3.0	4,242	14	29.0	2.1	3,190	0	0.0	0.0	28	71.0	7,432	

Runtime Data (Daily)
Tewksbury DPW Water and Sewer - Devonshire Road P.S. (G)
1 Jan 2024 12 AM - 1 Jan 2025 12 AM
(**NOTE:** Gallons field is hidden for Zero pump capacity)

Date/Time	Pump 1				Pump 2				Intrusion			Total			Rainfall (Inches)
	Starts	Runtime	Average	Gallons	Starts	Runtime	Average	Gallons	Starts	Runtime	Average	Starts	Runtime	Gallons	KLWM:Lawrence
19 Mar 2024	15	45.0	3.0	4,545	14	28.0	2.0	3,080	0	0.0	0.0	29	73.0	7,625	
20 Mar 2024	14	38.0	2.7	3,838	15	32.0	2.1	3,520	0	0.0	0.0	29	70.0	7,358	
21 Mar 2024	14	38.0	2.7	3,838	14	29.0	2.1	3,190	0	0.0	0.0	28	67.0	7,028	
22 Mar 2024	14	36.0	2.6	3,636	13	26.0	2.0	2,860	0	0.0	0.0	27	62.0	6,496	
23 Mar 2024	26	92.0	3.5	9,292	26	62.0	2.4	6,820	0	0.0	0.0	52	154.0	16,112	
24 Mar 2024	40	147.0	3.7	14,847	41	102.0	2.5	11,220	0	0.0	0.0	81	249.0	26,067	
25 Mar 2024	21	63.0	3.0	6,363	20	42.0	2.1	4,620	0	0.0	0.0	41	105.0	10,983	
26 Mar 2024	19	58.0	3.1	5,858	19	38.0	2.0	4,180	0	0.0	0.0	38	96.0	10,038	
27 Mar 2024	15	45.0	3.0	4,545	15	30.0	2.0	3,300	0	0.0	0.0	30	75.0	7,845	
28 Mar 2024	24	79.0	3.3	7,979	24	52.0	2.2	5,720	0	0.0	0.0	48	131.0	13,699	
29 Mar 2024	44	175.0	4.0	17,675	45	114.0	2.5	12,540	0	0.0	0.0	89	289.0	30,215	
30 Mar 2024	22	68.0	3.1	6,868	22	46.0	2.1	5,060	0	0.0	0.0	44	114.0	11,928	
31 Mar 2024	25	68.0	2.7	6,868	25	137.0	5.5	15,070	0	0.0	0.0	50	205.0	21,938	
1 Apr 2024	18	54.0	3.0	5,454	17	51.0	3.0	5,610	0	0.0	0.0	35	105.0	11,064	0.00
2 Apr 2024	16	49.0	3.1	4,949	16	48.0	3.0	5,280	0	0.0	0.0	32	97.0	10,229	0.00
3 Apr 2024	15	44.0	2.9	4,444	15	45.0	3.0	4,950	0	0.0	0.0	30	89.0	9,394	0.68
4 Apr 2024	33	125.0	3.8	12,625	34	114.0	3.4	12,540	0	0.0	0.0	67	239.0	25,165	1.06
5 Apr 2024	30	103.0	3.4	10,403	29	93.0	3.2	10,230	0	0.0	0.0	59	196.0	20,633	0.06
6 Apr 2024	23	73.0	3.2	7,373	23	73.0	3.2	8,030	0	0.0	0.0	46	146.0	15,403	0.14
7 Apr 2024	22	74.0	3.4	7,474	22	66.0	3.0	7,260	0	0.0	0.0	44	140.0	14,734	0.00
8 Apr 2024	20	67.0	3.4	6,767	21	63.0	3.0	6,930	0	0.0	0.0	41	130.0	13,697	0.00
9 Apr 2024	18	57.0	3.2	5,757	18	55.0	3.1	6,050	0	0.0	0.0	36	112.0	11,807	0.00
10 Apr 2024	17	56.0	3.3	5,656	16	48.0	3.0	5,280	0	0.0	0.0	33	104.0	10,936	0.13
11 Apr 2024	16	51.0	3.2	5,151	16	48.0	3.0	5,280	0	0.0	0.0	32	99.0	10,431	0.09
12 Apr 2024	23	72.0	3.1	7,272	23	75.0	3.3	8,250	0	0.0	0.0	46	147.0	15,522	0.66
13 Apr 2024	19	61.0	3.2	6,161	20	63.0	3.2	6,930	0	0.0	0.0	39	124.0	13,091	0.00
14 Apr 2024	19	60.0	3.2	6,060	19	58.0	3.1	6,380	0	0.0	0.0	38	118.0	12,440	0.04
15 Apr 2024	16	48.0	3.0	4,848	15	46.0	3.1	5,060	0	0.0	0.0	31	94.0	9,908	0.00
16 Apr 2024	14	43.0	3.1	4,343	15	45.0	3.0	4,950	0	0.0	0.0	29	88.0	9,293	0.00
17 Apr 2024	14	42.0	3.0	4,242	14	42.0	3.0	4,620	0	0.0	0.0	28	84.0	8,862	0.00
18 Apr 2024	14	42.0	3.0	4,242	14	42.0	3.0	4,620	0	0.0	0.0	28	84.0	8,862	0.10
19 Apr 2024	14	42.0	3.0	4,242	13	40.0	3.1	4,400	0	0.0	0.0	27	82.0	8,642	0.00
20 Apr 2024	13	39.0	3.0	3,939	14	44.0	3.1	4,840	0	0.0	0.0	27	83.0	8,779	0.33
21 Apr 2024	15	45.0	3.0	4,545	15	45.0	3.0	4,950	0	0.0	0.0	30	90.0	9,495	0.00
22 Apr 2024	14	42.0	3.0	4,242	13	39.0	3.0	4,290	0	0.0	0.0	27	81.0	8,532	0.00
23 Apr 2024	13	39.0	3.0	3,939	13	38.0	2.9	4,180	0	0.0	0.0	26	77.0	8,119	0.00
24 Apr 2024	13	39.0	3.0	3,939	13	38.0	2.9	4,180	0	0.0	0.0	26	77.0	8,119	0.04
25 Apr 2024	12	36.0	3.0	3,636	12	31.0	2.6	3,410	0	0.0	0.0	24	67.0	7,046	0.00
26 Apr 2024	12	33.0	2.8	3,333	13	31.0	2.4	3,410	0	0.0	0.0	25	64.0	6,743	0.00

Runtime Data (Daily)
Tewksbury DPW Water and Sewer - Devonshire Road P.S. (G)
1 Jan 2024 12 AM - 1 Jan 2025 12 AM
(**NOTE:** Gallons field is hidden for Zero pump capacity)

Date/Time	Pump 1				Pump 2				Intrusion			Total			Rainfall (Inches)
	Starts	Runtime	Average	Gallons	Starts	Runtime	Average	Gallons	Starts	Runtime	Average	Starts	Runtime	Gallons	KLWM:Lawrence
27 Apr 2024	13	36.0	2.8	3,636	13	35.0	2.7	3,850	0	0.0	0.0	26	71.0	7,486	0.00
28 Apr 2024	14	35.0	2.5	3,535	13	30.0	2.3	3,300	0	0.0	0.0	27	65.0	6,835	0.01
29 Apr 2024	12	36.0	3.0	3,636	12	34.0	2.8	3,740	0	0.0	0.0	24	70.0	7,376	0.00
30 Apr 2024	13	39.0	3.0	3,939	13	38.0	2.9	4,180	0	0.0	0.0	26	77.0	8,119	0.13
1 May 2024	12	36.0	3.0	3,636	13	39.0	3.0	4,290	0	0.0	0.0	25	75.0	7,926	0.23
2 May 2024	13	38.0	2.9	3,838	13	29.0	2.2	3,190	0	0.0	0.0	26	67.0	7,028	0.04
3 May 2024	12	36.0	3.0	3,636	12	26.0	2.2	2,860	0	0.0	0.0	24	62.0	6,496	0.00
4 May 2024	14	43.0	3.1	4,343	13	32.0	2.5	3,520	0	0.0	0.0	27	75.0	7,863	0.00
5 May 2024	14	42.0	3.0	4,242	15	34.0	2.3	3,740	0	0.0	0.0	29	76.0	7,982	0.36
6 May 2024	15	47.0	3.1	4,747	13	27.0	2.1	2,970	0	0.0	0.0	28	74.0	7,717	0.09
7 May 2024	13	39.0	3.0	3,939	13	27.0	2.1	2,970	0	0.0	0.0	26	66.0	6,909	0.00
8 May 2024	14	43.0	3.1	4,343	14	29.0	2.1	3,190	0	0.0	0.0	28	72.0	7,533	0.49
9 May 2024	13	39.0	3.0	3,939	14	31.0	2.2	3,410	0	0.0	0.0	27	70.0	7,349	0.00
10 May 2024	14	42.0	3.0	4,242	13	39.0	3.0	4,290	0	0.0	0.0	27	81.0	8,532	0.00
11 May 2024	13	40.0	3.1	4,040	13	39.0	3.0	4,290	0	0.0	0.0	26	79.0	8,330	0.00
12 May 2024	15	46.0	3.1	4,646	15	45.0	3.0	4,950	0	0.0	0.0	30	91.0	9,596	0.00
13 May 2024	12	35.0	2.9	3,535	13	38.0	2.9	4,180	0	0.0	0.0	25	73.0	7,715	0.00
14 May 2024	13	39.0	3.0	3,939	13	39.0	3.0	4,290	0	0.0	0.0	26	78.0	8,229	0.00
15 May 2024	12	35.0	2.9	3,535	12	36.0	3.0	3,960	0	0.0	0.0	24	71.0	7,495	0.02
16 May 2024	13	39.0	3.0	3,939	12	36.0	3.0	3,960	0	0.0	0.0	25	75.0	7,899	0.28
17 May 2024	13	40.0	3.1	4,040	13	38.0	2.9	4,180	0	0.0	0.0	26	78.0	8,220	0.02
18 May 2024	12	36.0	3.0	3,636	12	36.0	3.0	3,960	0	0.0	0.0	24	72.0	7,596	0.23
19 May 2024	13	39.0	3.0	3,939	13	40.0	3.1	4,400	0	0.0	0.0	26	79.0	8,339	2.17
20 May 2024	12	36.0	3.0	3,636	13	36.0	2.8	3,960	0	0.0	0.0	25	72.0	7,596	1.42
21 May 2024	12	37.0	3.1	3,737	12	35.0	2.9	3,850	0	0.0	0.0	24	72.0	7,587	0.18
22 May 2024	13	40.0	3.1	4,040	13	40.0	3.1	4,400	0	0.0	0.0	26	80.0	8,440	0.00
23 May 2024	13	40.0	3.1	4,040	13	40.0	3.1	4,400	0	0.0	0.0	26	80.0	8,440	0.38
24 May 2024	13	41.0	3.2	4,141	13	39.0	3.0	4,290	0	0.0	0.0	26	80.0	8,431	0.00
25 May 2024	12	37.0	3.1	3,737	11	33.0	3.0	3,630	0	0.0	0.0	23	70.0	7,367	0.00
26 May 2024	10	30.0	3.0	3,030	11	31.0	2.8	3,410	0	0.0	0.0	21	61.0	6,440	0.10
27 May 2024	13	39.0	3.0	3,939	13	38.0	2.9	4,180	0	0.0	0.0	26	77.0	8,119	0.40
28 May 2024	14	41.0	2.9	4,141	14	41.0	2.9	4,510	0	0.0	0.0	28	82.0	8,651	0.07
29 May 2024	12	35.0	2.9	3,535	12	36.0	3.0	3,960	0	0.0	0.0	24	71.0	7,495	0.00
30 May 2024	14	43.0	3.1	4,343	14	42.0	3.0	4,620	0	0.0	0.0	28	85.0	8,963	1.25
31 May 2024	12	36.0	3.0	3,636	12	36.0	3.0	3,960	0	0.0	0.0	24	72.0	7,596	0.00
1 Jun 2024	17	52.0	3.1	5,252	16	48.0	3.0	5,280	0	0.0	0.0	33	100.0	10,532	0.00
2 Jun 2024	14	44.0	3.1	4,444	14	42.0	3.0	4,620	0	0.0	0.0	28	86.0	9,064	0.00
3 Jun 2024	11	36.0	3.3	3,636	12	36.0	3.0	3,960	0	0.0	0.0	23	72.0	7,596	0.24
4 Jun 2024	12	37.0	3.1	3,737	12	36.0	3.0	3,960	0	0.0	0.0	24	73.0	7,697	0.00

Runtime Data (Daily)
Tewksbury DPW Water and Sewer - Devonshire Road P.S. (G)
1 Jan 2024 12 AM - 1 Jan 2025 12 AM
(**NOTE:** Gallons field is hidden for Zero pump capacity)

Date/Time	Pump 1				Pump 2				Intrusion			Total			Rainfall (Inches)
	Starts	Runtime	Average	Gallons	Starts	Runtime	Average	Gallons	Starts	Runtime	Average	Starts	Runtime	Gallons	KLWM:Lawrence
5 Jun 2024	12	37.0	3.1	3,737	11	32.0	2.9	3,520	0	0.0	0.0	23	69.0	7,257	0.10
6 Jun 2024	11	33.0	3.0	3,333	12	36.0	3.0	3,960	0	0.0	0.0	23	69.0	7,293	0.80
7 Jun 2024	12	36.0	3.0	3,636	11	33.0	3.0	3,630	0	0.0	0.0	23	69.0	7,266	0.97
8 Jun 2024	12	37.0	3.1	3,737	13	40.0	3.1	4,400	0	0.0	0.0	25	77.0	8,137	1.99
9 Jun 2024	13	39.0	3.0	3,939	12	36.0	3.0	3,960	0	0.0	0.0	25	75.0	7,899	0.26
10 Jun 2024	11	33.0	3.0	3,333	12	36.0	3.0	3,960	0	0.0	0.0	23	69.0	7,293	0.00
11 Jun 2024	12	39.0	3.2	3,939	12	36.0	3.0	3,960	0	0.0	0.0	24	75.0	7,899	0.03
12 Jun 2024	11	33.0	3.0	3,333	11	33.0	3.0	3,630	0	0.0	0.0	22	66.0	6,963	0.00
13 Jun 2024	11	33.0	3.0	3,333	11	33.0	3.0	3,630	0	0.0	0.0	22	66.0	6,963	0.00
14 Jun 2024	12	37.0	3.1	3,737	12	36.0	3.0	3,960	0	0.0	0.0	24	73.0	7,697	0.21
15 Jun 2024	13	39.0	3.0	3,939	12	36.0	3.0	3,960	0	0.0	0.0	25	75.0	7,899	0.04
16 Jun 2024	14	33.0	2.4	3,333	15	36.0	2.4	3,960	0	0.0	0.0	29	69.0	7,293	0.10
17 Jun 2024	13	40.0	3.1	4,040	12	34.0	2.8	3,740	0	0.0	0.0	25	74.0	7,780	0.00
18 Jun 2024	11	33.0	3.0	3,333	12	35.0	2.9	3,850	0	0.0	0.0	23	68.0	7,183	0.00
19 Jun 2024	13	40.0	3.1	4,040	13	39.0	3.0	4,290	0	0.0	0.0	26	79.0	8,330	0.55
20 Jun 2024	12	36.0	3.0	3,636	11	33.0	3.0	3,630	0	0.0	0.0	23	69.0	7,266	0.39
21 Jun 2024	11	33.0	3.0	3,333	11	33.0	3.0	3,630	0	0.0	0.0	22	66.0	6,963	0.02
22 Jun 2024	11	33.0	3.0	3,333	12	35.0	2.9	3,850	0	0.0	0.0	23	68.0	7,183	0.10
23 Jun 2024	12	36.0	3.0	3,636	12	36.0	3.0	3,960	0	0.0	0.0	24	72.0	7,596	0.10
24 Jun 2024	12	36.0	3.0	3,636	12	36.0	3.0	3,960	0	0.0	0.0	24	72.0	7,596	1.21
25 Jun 2024	12	37.0	3.1	3,737	12	36.0	3.0	3,960	0	0.0	0.0	24	73.0	7,697	0.28
26 Jun 2024	12	37.0	3.1	3,737	11	31.0	2.8	3,410	0	0.0	0.0	23	68.0	7,147	0.00
27 Jun 2024	10	30.0	3.0	3,030	11	33.0	3.0	3,630	0	0.0	0.0	21	63.0	6,660	0.13
28 Jun 2024	12	35.0	2.9	3,535	11	33.0	3.0	3,630	0	0.0	0.0	23	68.0	7,165	0.00
29 Jun 2024	10	29.0	2.9	2,929	10	30.0	3.0	3,300	0	0.0	0.0	20	59.0	6,229	0.05
30 Jun 2024	11	26.0	2.4	2,626	11	33.0	3.0	3,630	0	0.0	0.0	22	59.0	6,256	0.00
1 Jul 2024	10	20.0	2.0	2,020	11	26.0	2.4	2,860	0	0.0	0.0	21	46.0	4,880	0.00
2 Jul 2024	11	30.0	2.7	3,030	11	28.0	2.5	3,080	0	0.0	0.0	22	58.0	6,110	0.00
3 Jul 2024	12	36.0	3.0	3,636	12	33.0	2.8	3,630	0	0.0	0.0	24	69.0	7,266	0.00
4 Jul 2024	10	31.0	3.1	3,131	10	30.0	3.0	3,300	0	0.0	0.0	20	61.0	6,431	0.12
5 Jul 2024	12	36.0	3.0	3,636	11	30.0	2.7	3,300	0	0.0	0.0	23	66.0	6,936	0.02
6 Jul 2024	10	30.0	3.0	3,030	11	24.0	2.2	2,640	0	0.0	0.0	21	54.0	5,670	0.00
7 Jul 2024	13	39.0	3.0	3,939	12	34.0	2.8	3,740	0	0.0	0.0	25	73.0	7,679	1.14
8 Jul 2024	12	36.0	3.0	3,636	13	27.0	2.1	2,970	0	0.0	0.0	25	63.0	6,606	0.33
9 Jul 2024	12	34.0	2.8	3,434	12	26.0	2.2	2,860	0	0.0	0.0	24	60.0	6,294	1.04
10 Jul 2024	12	37.0	3.1	3,737	12	33.0	2.8	3,630	0	0.0	0.0	24	70.0	7,367	0.00
11 Jul 2024	12	37.0	3.1	3,737	11	30.0	2.7	3,300	0	0.0	0.0	23	67.0	7,037	0.00
12 Jul 2024	12	36.0	3.0	3,636	12	33.0	2.8	3,630	0	0.0	0.0	24	69.0	7,266	0.00
13 Jul 2024	14	42.0	3.0	4,242	14	37.0	2.6	4,070	0	0.0	0.0	28	79.0	8,312	0.13

Runtime Data (Daily)
Tewksbury DPW Water and Sewer - Devonshire Road P.S. (G)
1 Jan 2024 12 AM - 1 Jan 2025 12 AM
(**NOTE:** Gallons field is hidden for Zero pump capacity)

Date/Time	Pump 1				Pump 2				Intrusion			Total			Rainfall (Inches)
	Starts	Runtime	Average	Gallons	Starts	Runtime	Average	Gallons	Starts	Runtime	Average	Starts	Runtime	Gallons	KLWM:Lawrence
14 Jul 2024	12	36.0	3.0	3,636	12	27.0	2.2	2,970	0	0.0	0.0	24	63.0	6,606	0.00
15 Jul 2024	12	36.0	3.0	3,636	12	25.0	2.1	2,750	0	0.0	0.0	24	61.0	6,386	0.00
16 Jul 2024	11	33.0	3.0	3,333	11	30.0	2.7	3,300	0	0.0	0.0	22	63.0	6,633	0.74
17 Jul 2024	12	35.0	2.9	3,535	12	29.0	2.4	3,190	0	0.0	0.0	24	64.0	6,725	0.17
18 Jul 2024	10	30.0	3.0	3,030	11	26.0	2.4	2,860	0	0.0	0.0	21	56.0	5,890	0.03
19 Jul 2024	13	40.0	3.1	4,040	12	33.0	2.8	3,630	0	0.0	0.0	25	73.0	7,670	0.00
20 Jul 2024	11	33.0	3.0	3,333	12	34.0	2.8	3,740	0	0.0	0.0	23	67.0	7,073	0.00
21 Jul 2024	12	36.0	3.0	3,636	12	36.0	3.0	3,960	0	0.0	0.0	24	72.0	7,596	0.02
22 Jul 2024	13	39.0	3.0	3,939	12	34.0	2.8	3,740	0	0.0	0.0	25	73.0	7,679	0.00
23 Jul 2024	13	39.0	3.0	3,939	14	42.0	3.0	4,620	0	0.0	0.0	27	81.0	8,559	0.27
24 Jul 2024	12	37.0	3.1	3,737	11	32.0	2.9	3,520	0	0.0	0.0	23	69.0	7,257	0.00
25 Jul 2024	10	30.0	3.0	3,030	10	30.0	3.0	3,300	0	0.0	0.0	20	60.0	6,330	0.00
26 Jul 2024	11	33.0	3.0	3,333	12	36.0	3.0	3,960	0	0.0	0.0	23	69.0	7,293	0.26
27 Jul 2024	10	30.0	3.0	3,030	10	30.0	3.0	3,300	0	0.0	0.0	20	60.0	6,330	0.00
28 Jul 2024	12	36.0	3.0	3,636	11	34.0	3.1	3,740	0	0.0	0.0	23	70.0	7,376	0.00
29 Jul 2024	11	33.0	3.0	3,333	12	36.0	3.0	3,960	0	0.0	0.0	23	69.0	7,293	0.94
30 Jul 2024	12	36.0	3.0	3,636	11	33.0	3.0	3,630	0	0.0	0.0	23	69.0	7,266	0.00
31 Jul 2024	12	36.0	3.0	3,636	13	39.0	3.0	4,290	0	0.0	0.0	25	75.0	7,926	0.21
1 Aug 2024	11	34.0	3.1	3,434	10	29.0	2.9	3,190	0	0.0	0.0	21	63.0	6,624	0.00
2 Aug 2024	11	34.0	3.1	3,434	12	36.0	3.0	3,960	0	0.0	0.0	23	70.0	7,394	0.33
3 Aug 2024	15	45.0	3.0	4,545	14	42.0	3.0	4,620	0	0.0	0.0	29	87.0	9,165	0.05
4 Aug 2024	13	39.0	3.0	3,939	13	40.0	3.1	4,400	0	0.0	0.0	26	79.0	8,339	1.38
5 Aug 2024	13	40.0	3.1	4,040	14	42.0	3.0	4,620	0	0.0	0.0	27	82.0	8,660	0.00
6 Aug 2024	13	40.0	3.1	4,040	12	36.0	3.0	3,960	0	0.0	0.0	25	76.0	8,000	0.44
7 Aug 2024	13	38.0	2.9	3,838	14	42.0	3.0	4,620	0	0.0	0.0	27	80.0	8,458	0.67
8 Aug 2024	13	31.0	2.4	3,131	12	36.0	3.0	3,960	0	0.0	0.0	25	67.0	7,091	0.19
9 Aug 2024	12	32.0	2.7	3,232	12	36.0	3.0	3,960	0	0.0	0.0	24	68.0	7,192	0.24
10 Aug 2024	12	37.0	3.1	3,737	12	36.0	3.0	3,960	0	0.0	0.0	24	73.0	7,697	0.26
11 Aug 2024	13	40.0	3.1	4,040	13	37.0	2.8	4,070	0	0.0	0.0	26	77.0	8,110	0.00
12 Aug 2024	12	36.0	3.0	3,636	13	35.0	2.7	3,850	0	0.0	0.0	25	71.0	7,486	0.00
13 Aug 2024	13	39.0	3.0	3,939	13	28.0	2.2	3,080	0	0.0	0.0	26	67.0	7,019	0.00
14 Aug 2024	12	34.0	2.8	3,434	12	26.0	2.2	2,860	0	0.0	0.0	24	60.0	6,294	0.00
15 Aug 2024	12	36.0	3.0	3,636	12	28.0	2.3	3,080	0	0.0	0.0	24	64.0	6,716	0.42
16 Aug 2024	11	28.0	2.5	2,828	11	22.0	2.0	2,420	0	0.0	0.0	22	50.0	5,248	0.04
17 Aug 2024	12	28.0	2.3	2,828	12	24.0	2.0	2,640	0	0.0	0.0	24	52.0	5,468	0.00
18 Aug 2024	12	24.0	2.0	2,424	12	25.0	2.1	2,750	0	0.0	0.0	24	49.0	5,174	0.23
19 Aug 2024	13	26.0	2.0	2,626	12	24.0	2.0	2,640	0	0.0	0.0	25	50.0	5,266	0.78
20 Aug 2024	12	24.0	2.0	2,424	12	24.0	2.0	2,640	0	0.0	0.0	24	48.0	5,064	0.00
21 Aug 2024	12	24.0	2.0	2,424	13	28.0	2.2	3,080	0	0.0	0.0	25	52.0	5,504	0.00

Runtime Data (Daily)
Tewksbury DPW Water and Sewer - Devonshire Road P.S. (G)
1 Jan 2024 12 AM - 1 Jan 2025 12 AM
(**NOTE:** Gallons field is hidden for Zero pump capacity)

Date/Time	Pump 1				Pump 2				Intrusion			Total			Rainfall (Inches)
	Starts	Runtime	Average	Gallons	Starts	Runtime	Average	Gallons	Starts	Runtime	Average	Starts	Runtime	Gallons	KLWM:Lawrence
22 Aug 2024	11	22.0	2.0	2,222	11	22.0	2.0	2,420	0	0.0	0.0	22	44.0	4,642	0.00
23 Aug 2024	11	23.0	2.1	2,323	11	22.0	2.0	2,420	0	0.0	0.0	22	45.0	4,743	0.28
24 Aug 2024	11	23.0	2.1	2,323	11	22.0	2.0	2,420	0	0.0	0.0	22	45.0	4,743	0.00
25 Aug 2024	12	24.0	2.0	2,424	11	23.0	2.1	2,530	0	0.0	0.0	23	47.0	4,954	0.00
26 Aug 2024	12	25.0	2.1	2,525	12	24.0	2.0	2,640	0	0.0	0.0	24	49.0	5,165	0.22
27 Aug 2024	12	25.0	2.1	2,525	13	26.0	2.0	2,860	0	0.0	0.0	25	51.0	5,385	0.00
28 Aug 2024	12	25.0	2.1	2,525	11	22.0	2.0	2,420	0	0.0	0.0	23	47.0	4,945	0.00
29 Aug 2024	11	23.0	2.1	2,323	12	22.0	1.8	2,420	0	0.0	0.0	23	45.0	4,743	0.00
30 Aug 2024	11	22.0	2.0	2,222	11	24.0	2.2	2,640	0	0.0	0.0	22	46.0	4,862	0.00
31 Aug 2024	10	21.0	2.1	2,121	10	20.0	2.0	2,200	0	0.0	0.0	20	41.0	4,321	0.06
1 Sep 2024	12	25.0	2.1	2,525	11	22.0	2.0	2,420	0	0.0	0.0	23	47.0	4,945	0.00
2 Sep 2024	13	26.0	2.0	2,626	13	26.0	2.0	2,860	0	0.0	0.0	26	52.0	5,486	0.00
3 Sep 2024	12	24.0	2.0	2,424	13	26.0	2.0	2,860	0	0.0	0.0	25	50.0	5,284	0.00
4 Sep 2024	13	27.0	2.1	2,727	13	26.0	2.0	2,860	0	0.0	0.0	26	53.0	5,587	0.00
5 Sep 2024	13	26.0	2.0	2,626	13	26.0	2.0	2,860	0	0.0	0.0	26	52.0	5,486	0.00
6 Sep 2024	11	22.0	2.0	2,222	11	22.0	2.0	2,420	0	0.0	0.0	22	44.0	4,642	0.00
7 Sep 2024	12	24.0	2.0	2,424	11	22.0	2.0	2,420	0	0.0	0.0	23	46.0	4,844	0.02
8 Sep 2024	12	24.0	2.0	2,424	13	26.0	2.0	2,860	0	0.0	0.0	25	50.0	5,284	0.00
9 Sep 2024	13	26.0	2.0	2,626	12	25.0	2.1	2,750	0	0.0	0.0	25	51.0	5,376	0.00
10 Sep 2024	12	24.0	2.0	2,424	12	24.0	2.0	2,640	0	0.0	0.0	24	48.0	5,064	0.00
11 Sep 2024	12	24.0	2.0	2,424	13	26.0	2.0	2,860	0	0.0	0.0	25	50.0	5,284	0.00
12 Sep 2024	11	22.0	2.0	2,222	11	22.0	2.0	2,420	0	0.0	0.0	22	44.0	4,642	0.00
13 Sep 2024	12	25.0	2.1	2,525	12	24.0	2.0	2,640	0	0.0	0.0	24	49.0	5,165	0.00
14 Sep 2024	11	22.0	2.0	2,222	11	23.0	2.1	2,530	0	0.0	0.0	22	45.0	4,752	0.00
15 Sep 2024	13	26.0	2.0	2,626	12	24.0	2.0	2,640	0	0.0	0.0	25	50.0	5,266	0.00
16 Sep 2024	11	23.0	2.1	2,323	12	24.0	2.0	2,640	0	0.0	0.0	23	47.0	4,963	0.00
17 Sep 2024	12	24.0	2.0	2,424	12	24.0	2.0	2,640	0	0.0	0.0	24	48.0	5,064	0.02
18 Sep 2024	12	24.0	2.0	2,424	12	24.0	2.0	2,640	0	0.0	0.0	24	48.0	5,064	0.00
19 Sep 2024	11	23.0	2.1	2,323	11	23.0	2.1	2,530	0	0.0	0.0	22	46.0	4,853	0.01
20 Sep 2024	12	24.0	2.0	2,424	12	26.0	2.2	2,860	0	0.0	0.0	24	50.0	5,284	0.03
21 Sep 2024	13	26.0	2.0	2,626	13	37.0	2.8	4,070	0	0.0	0.0	26	63.0	6,696	0.59
22 Sep 2024	13	27.0	2.1	2,727	13	36.0	2.8	3,960	0	0.0	0.0	26	63.0	6,687	0.07
23 Sep 2024	13	26.0	2.0	2,626	12	36.0	3.0	3,960	0	0.0	0.0	25	62.0	6,586	0.00
24 Sep 2024	12	24.0	2.0	2,424	12	35.0	2.9	3,850	0	0.0	0.0	24	59.0	6,274	0.00
25 Sep 2024	12	24.0	2.0	2,424	12	35.0	2.9	3,850	0	0.0	0.0	24	59.0	6,274	0.00
26 Sep 2024	11	23.0	2.1	2,323	12	36.0	3.0	3,960	0	0.0	0.0	23	59.0	6,283	0.38
27 Sep 2024	13	27.0	2.1	2,727	12	36.0	3.0	3,960	0	0.0	0.0	25	63.0	6,687	0.00
28 Sep 2024	11	23.0	2.1	2,323	11	30.0	2.7	3,300	0	0.0	0.0	22	53.0	5,623	0.00
29 Sep 2024	12	25.0	2.1	2,525	12	36.0	3.0	3,960	0	0.0	0.0	24	61.0	6,485	0.00

Runtime Data (Daily)
Tewksbury DPW Water and Sewer - Devonshire Road P.S. (G)
1 Jan 2024 12 AM - 1 Jan 2025 12 AM
(**NOTE:** Gallons field is hidden for Zero pump capacity)

Date/Time	Pump 1				Pump 2				Intrusion			Total			Rainfall (Inches)
	Starts	Runtime	Average	Gallons	Starts	Runtime	Average	Gallons	Starts	Runtime	Average	Starts	Runtime	Gallons	KLWM:Lawrence
30 Sep 2024	13	27.0	2.1	2,727	13	38.0	2.9	4,180	0	0.0	0.0	26	65.0	6,907	0.00
1 Oct 2024	11	24.0	2.2	2,424	11	23.0	2.1	2,530	0	0.0	0.0	22	47.0	4,954	0.00
2 Oct 2024	11	22.0	2.0	2,222	12	34.0	2.8	3,740	0	0.0	0.0	23	56.0	5,962	0.00
3 Oct 2024	12	24.0	2.0	2,424	11	29.0	2.6	3,190	0	0.0	0.0	23	53.0	5,614	0.00
4 Oct 2024	10	20.0	2.0	2,020	11	32.0	2.9	3,520	0	0.0	0.0	21	52.0	5,540	0.02
5 Oct 2024	13	26.0	2.0	2,626	13	36.0	2.8	3,960	0	0.0	0.0	26	62.0	6,586	0.01
6 Oct 2024	14	28.0	2.0	2,828	14	42.0	3.0	4,620	0	0.0	0.0	28	70.0	7,448	0.00
7 Oct 2024	13	26.0	2.0	2,626	12	36.0	3.0	3,960	0	0.0	0.0	25	62.0	6,586	0.36
8 Oct 2024	11	22.0	2.0	2,222	12	32.0	2.7	3,520	0	0.0	0.0	23	54.0	5,742	0.00
9 Oct 2024	11	22.0	2.0	2,222	11	32.0	2.9	3,520	0	0.0	0.0	22	54.0	5,742	0.00
10 Oct 2024	11	22.0	2.0	2,222	10	28.0	2.8	3,080	0	0.0	0.0	21	50.0	5,302	0.00
11 Oct 2024	12	25.0	2.1	2,525	13	27.0	2.1	2,970	0	0.0	0.0	25	52.0	5,495	0.00
12 Oct 2024	11	26.0	2.4	2,626	10	25.0	2.5	2,750	0	0.0	0.0	21	51.0	5,376	0.00
13 Oct 2024	12	36.0	3.0	3,636	12	36.0	3.0	3,960	0	0.0	0.0	24	72.0	7,596	0.14
14 Oct 2024	13	39.0	3.0	3,939	12	36.0	3.0	3,960	0	0.0	0.0	25	75.0	7,899	0.96
15 Oct 2024	12	36.0	3.0	3,636	13	38.0	2.9	4,180	0	0.0	0.0	25	74.0	7,816	0.00
16 Oct 2024	13	39.0	3.0	3,939	13	36.0	2.8	3,960	0	0.0	0.0	26	75.0	7,899	0.00
17 Oct 2024	11	33.0	3.0	3,333	11	27.0	2.5	2,970	0	0.0	0.0	22	60.0	6,303	0.00
18 Oct 2024	11	33.0	3.0	3,333	10	29.0	2.9	3,190	0	0.0	0.0	21	62.0	6,523	0.00
19 Oct 2024	11	34.0	3.1	3,434	11	30.0	2.7	3,300	0	0.0	0.0	22	64.0	6,734	0.00
20 Oct 2024	12	36.0	3.0	3,636	12	32.0	2.7	3,520	0	0.0	0.0	24	68.0	7,156	0.00
21 Oct 2024	11	33.0	3.0	3,333	11	29.0	2.6	3,190	0	0.0	0.0	22	62.0	6,523	0.00
22 Oct 2024	11	34.0	3.1	3,434	12	27.0	2.2	2,970	0	0.0	0.0	23	61.0	6,404	0.00
23 Oct 2024	12	38.0	3.2	3,838	12	30.0	2.5	3,300	0	0.0	0.0	24	68.0	7,138	0.02
24 Oct 2024	12	37.0	3.1	3,737	12	33.0	2.8	3,630	0	0.0	0.0	24	70.0	7,367	2.07
25 Oct 2024	12	36.0	3.0	3,636	11	23.0	2.1	2,530	0	0.0	0.0	23	59.0	6,166	0.34
26 Oct 2024	12	37.0	3.1	3,737	12	25.0	2.1	2,750	0	0.0	0.0	24	62.0	6,487	0.20
27 Oct 2024	16	49.0	3.1	4,949	17	49.0	2.9	5,390	0	0.0	0.0	33	98.0	10,339	0.00
28 Oct 2024	25	96.0	3.8	9,696	17	28.0	1.6	3,080	0	0.0	0.0	42	124.0	12,776	0.00
29 Oct 2024	11	32.0	2.9	3,232	11	30.0	2.7	3,300	0	0.0	0.0	22	62.0	6,532	0.02
30 Oct 2024	11	33.0	3.0	3,333	11	31.0	2.8	3,410	0	0.0	0.0	22	64.0	6,743	0.26
31 Oct 2024	17	51.0	3.0	5,151	13	31.0	2.4	3,410	0	0.0	0.0	30	82.0	8,561	0.00
1 Nov 2024	10	30.0	3.0	3,030	10	28.0	2.8	3,080	0	0.0	0.0	20	58.0	6,110	0.00
2 Nov 2024	12	36.0	3.0	3,636	13	37.0	2.8	4,070	0	0.0	0.0	25	73.0	7,706	0.00
3 Nov 2024	12	38.0	3.2	3,838	12	30.0	2.5	3,300	0	0.0	0.0	24	68.0	7,138	0.00
4 Nov 2024	12	37.0	3.1	3,737	11	32.0	2.9	3,520	0	0.0	0.0	23	69.0	7,257	0.00
5 Nov 2024	11	37.0	3.4	3,737	11	33.0	3.0	3,630	0	0.0	0.0	22	70.0	7,367	0.73
6 Nov 2024	14	73.0	5.2	7,373	13	37.0	2.8	4,070	0	0.0	0.0	27	110.0	11,443	0.64
7 Nov 2024	10	33.0	3.3	3,333	11	28.0	2.5	3,080	0	0.0	0.0	21	61.0	6,413	0.00

Runtime Data (Daily)
Tewksbury DPW Water and Sewer - Devonshire Road P.S. (G)
1 Jan 2024 12 AM - 1 Jan 2025 12 AM
(**NOTE:** Gallons field is hidden for Zero pump capacity)

Date/Time	Pump 1				Pump 2				Intrusion			Total			Rainfall (Inches)
	Starts	Runtime	Average	Gallons	Starts	Runtime	Average	Gallons	Starts	Runtime	Average	Starts	Runtime	Gallons	KLWM:Lawrence
8 Nov 2024	11	33.0	3.0	3,333	11	27.0	2.5	2,970	0	0.0	0.0	22	60.0	6,303	0.00
9 Nov 2024	12	38.0	3.2	3,838	11	26.0	2.4	2,860	0	0.0	0.0	23	64.0	6,698	0.00
10 Nov 2024	11	34.0	3.1	3,434	11	26.0	2.4	2,860	0	0.0	0.0	22	60.0	6,294	0.03
11 Nov 2024	11	33.0	3.0	3,333	12	29.0	2.4	3,190	0	0.0	0.0	23	62.0	6,523	0.08
12 Nov 2024	11	36.0	3.3	3,636	10	21.0	2.1	2,310	0	0.0	0.0	21	57.0	5,946	0.00
13 Nov 2024	16	98.0	6.1	9,898	15	34.0	2.3	3,740	0	0.0	0.0	31	132.0	13,638	0.36
14 Nov 2024	23	185.0	8.0	18,685	22	44.0	2.0	4,840	0	0.0	0.0	45	229.0	23,525	0.00
15 Nov 2024	11	33.0	3.0	3,333	11	30.0	2.7	3,300	0	0.0	0.0	22	63.0	6,633	0.03
16 Nov 2024	14	43.0	3.1	4,343	14	38.0	2.7	4,180	0	0.0	0.0	28	81.0	8,523	0.00
17 Nov 2024	12	37.0	3.1	3,737	11	31.0	2.8	3,410	0	0.0	0.0	23	68.0	7,147	0.00
18 Nov 2024	12	38.0	3.2	3,838	12	36.0	3.0	3,960	0	0.0	0.0	24	74.0	7,798	0.09
19 Nov 2024	12	30.0	2.5	3,030	12	34.0	2.8	3,740	0	0.0	0.0	24	64.0	6,770	0.02
20 Nov 2024	11	33.0	3.0	3,333	11	34.0	3.1	3,740	0	0.0	0.0	22	67.0	7,073	0.29
21 Nov 2024	11	34.0	3.1	3,434	11	32.0	2.9	3,520	0	0.0	0.0	22	66.0	6,954	0.15
22 Nov 2024	12	36.0	3.0	3,636	13	39.0	3.0	4,290	0	0.0	0.0	25	75.0	7,926	0.33
23 Nov 2024	13	39.0	3.0	3,939	13	40.0	3.1	4,400	0	0.0	0.0	26	79.0	8,339	0.53
24 Nov 2024	13	39.0	3.0	3,939	12	36.0	3.0	3,960	0	0.0	0.0	25	75.0	7,899	0.00
25 Nov 2024	12	37.0	3.1	3,737	13	39.0	3.0	4,290	0	0.0	0.0	25	76.0	8,027	0.00
26 Nov 2024	12	37.0	3.1	3,737	11	32.0	2.9	3,520	0	0.0	0.0	23	69.0	7,257	0.28
27 Nov 2024	16	49.0	3.1	4,949	16	48.0	3.0	5,280	0	0.0	0.0	32	97.0	10,229	0.33
28 Nov 2024	14	42.0	3.0	4,242	14	42.0	3.0	4,620	0	0.0	0.0	28	84.0	8,862	0.83
29 Nov 2024	13	39.0	3.0	3,939	13	38.0	2.9	4,180	0	0.0	0.0	26	77.0	8,119	0.04
30 Nov 2024	11	33.0	3.0	3,333	12	36.0	3.0	3,960	0	0.0	0.0	23	69.0	7,293	0.00
1 Dec 2024	14	42.0	3.0	4,242	13	39.0	3.0	4,290	0	0.0	0.0	27	81.0	8,532	0.00
2 Dec 2024	12	37.0	3.1	3,737	13	39.0	3.0	4,290	0	0.0	0.0	25	76.0	8,027	0.00
3 Dec 2024	12	37.0	3.1	3,737	12	34.0	2.8	3,740	0	0.0	0.0	24	71.0	7,477	0.00
4 Dec 2024	12	36.0	3.0	3,636	12	36.0	3.0	3,960	0	0.0	0.0	24	72.0	7,596	0.04
5 Dec 2024	13	39.0	3.0	3,939	12	36.0	3.0	3,960	0	0.0	0.0	25	75.0	7,899	0.20
6 Dec 2024	11	33.0	3.0	3,333	11	32.0	2.9	3,520	0	0.0	0.0	22	65.0	6,853	0.00
7 Dec 2024	12	35.0	2.9	3,535	12	29.0	2.4	3,190	0	0.0	0.0	24	64.0	6,725	0.00
8 Dec 2024	12	36.0	3.0	3,636	12	24.0	2.0	2,640	0	0.0	0.0	24	60.0	6,276	0.02
9 Dec 2024	14	41.0	2.9	4,141	14	29.0	2.1	3,190	0	0.0	0.0	28	70.0	7,331	0.36
10 Dec 2024	12	32.0	2.7	3,232	12	25.0	2.1	2,750	0	0.0	0.0	24	57.0	5,982	0.03
11 Dec 2024	15	44.0	2.9	4,444	15	31.0	2.1	3,410	0	0.0	0.0	30	75.0	7,854	2.03
12 Dec 2024	15	45.0	3.0	4,545	16	32.0	2.0	3,520	0	0.0	0.0	31	77.0	8,065	0.00
13 Dec 2024	13	37.0	2.8	3,737	13	28.0	2.2	3,080	0	0.0	0.0	26	65.0	6,817	0.00
14 Dec 2024	14	37.0	2.6	3,737	14	31.0	2.2	3,410	0	0.0	0.0	28	68.0	7,147	0.00
15 Dec 2024	14	42.0	3.0	4,242	13	26.0	2.0	2,860	0	0.0	0.0	27	68.0	7,102	0.00
16 Dec 2024	12	36.0	3.0	3,636	13	27.0	2.1	2,970	0	0.0	0.0	25	63.0	6,606	0.01

Runtime Data (Daily)
Tewksbury DPW Water and Sewer - Devonshire Road P.S. (G)
1 Jan 2024 12 AM - 1 Jan 2025 12 AM
(**NOTE:** Gallons field is hidden for Zero pump capacity)

Date/Time	Pump 1				Pump 2				Intrusion			Total			Rainfall (Inches)
	Starts	Runtime	Average	Gallons	Starts	Runtime	Average	Gallons	Starts	Runtime	Average	Starts	Runtime	Gallons	KLWM:Lawrence
17 Dec 2024	14	40.0	2.9	4,040	14	30.0	2.1	3,300	0	0.0	0.0	28	70.0	7,340	0.17
18 Dec 2024	13	39.0	3.0	3,939	12	25.0	2.1	2,750	0	0.0	0.0	25	64.0	6,689	0.29
19 Dec 2024	14	42.0	3.0	4,242	14	32.0	2.3	3,520	0	0.0	0.0	28	74.0	7,762	0.10
20 Dec 2024	13	37.0	2.8	3,737	13	30.0	2.3	3,300	0	0.0	0.0	26	67.0	7,037	0.09
21 Dec 2024	14	35.0	2.5	3,535	14	32.0	2.3	3,520	0	0.0	0.0	28	67.0	7,055	0.00
22 Dec 2024	13	28.0	2.2	2,828	14	28.0	2.0	3,080	0	0.0	0.0	27	56.0	5,908	0.00
23 Dec 2024	14	34.0	2.4	3,434	14	29.0	2.1	3,190	0	0.0	0.0	28	63.0	6,624	0.00
24 Dec 2024	16	39.0	2.4	3,939	15	32.0	2.1	3,520	0	0.0	0.0	31	71.0	7,459	0.02
25 Dec 2024	13	36.0	2.8	3,636	13	28.0	2.2	3,080	0	0.0	0.0	26	64.0	6,716	0.00
26 Dec 2024	17	45.0	2.6	4,545	18	40.0	2.2	4,400	0	0.0	0.0	35	85.0	8,945	0.00
27 Dec 2024	12	29.0	2.4	2,929	12	23.0	1.9	2,530	0	0.0	0.0	24	52.0	5,459	0.00
28 Dec 2024	13	33.0	2.5	3,333	12	30.0	2.5	3,300	0	0.0	0.0	25	63.0	6,633	0.08
29 Dec 2024	13	31.0	2.4	3,131	13	31.0	2.4	3,410	0	0.0	0.0	26	62.0	6,541	0.00
30 Dec 2024	13	34.0	2.6	3,434	13	31.0	2.4	3,410	0	0.0	0.0	26	65.0	6,844	0.49
31 Dec 2024	13	34.0	2.6	3,434	13	29.0	2.2	3,190	0	0.0	0.0	26	63.0	6,624	0.00
Total	**5095**	**14391**	**2.824534**	**1453491**	**5076**	**12804**	**2.522459**	**1408440**	**0**	**0**	**0**	**10171**	**27195.0**	**2,861,931**	**59.45**

SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. This Section specifies general requirements for products, materials and equipment. This Section applies to all Specifications and Drawings and provisions of this Section may be supplemented in other sections of Division 01.

B. Certain provisions required by Laws and Regulations may be referenced. Contractor is responsible to determine and obtain applicable Laws and Regulations and to review and interpret the full text of such Laws and Regulations.

C. Section Includes

1.02 SOURCE QUALITY CONTROL
General
Independent Testing Agency Certification
Factory Testing

1.03 PRODUCT REQUIREMENTS
General
Transportation and Handling
Storage and Protection

1.04 WARRANTIES

1.02 SOURCE QUALITY CONTROL

A. General

1. Subject material and equipment furnished under the Contract Documents to a complete factory testing program as specified.

2. Shop Drawings and submittals: reviewed by Engineer before initiating testing program.

3. Perform checks and tests in accordance with manufacturer's recommendations and referenced standards.

4. Evaluate test results and advise Owner immediately of any discrepancy between test results and test limits or the failure of any device or system under test. Include test limits for acceptability applicable to each test on the certified test records.

5. Record test information, including the evaluation of testing results, on forms approved by Owner and Engineer.

B. Independent Testing Agency Certification

1. If specified, furnish certificates from an independent testing agency.

2. Independent testing agency to certify that material and equipment components have been examined and tested and are in conformance with the requirements specified in the Contract Documents.

3. Take Samples in accordance with the requirements specified in the Contract Documents, as selected by Owner or independent testing agency. Furnish and ship at no additional cost to Owner.

C. Factory Testing

1. Provide 14 days prior written notice of factory inspections and tests to Owner and Engineer.

2. If failure to give proper written notice results in material and equipment being assembled or covered before a factory inspection or test, make material and equipment ready for inspection or test and reassemble or recover at no additional cost to Owner.

3. Owner may inspect any portion of material and equipment furnished at any reasonable time during manufacture and may witness testing of any portion of material and equipment wherever located. Owner and Engineer to witness tests only.

4. Furnish, set up and operate test equipment and facilities.

5. If facilities for conducting required tests are unavailable to the manufacturer, conduct tests elsewhere or have them performed by an independent agency approved by Owner.

6. Protect material and equipment after testing and checking to provide that subsequent testing of other equipment or systems does not disturb, damage or otherwise interfere with functional capability of material and equipment.

7. Assume responsibility for protection of material and equipment and safety of all personnel during factory testing program.

8. Grounds for rejection: failure to withstand tests; failure to meet ratings; failure to meet applicable standards.

9. In the event of failure

   a. Submit revisions of documents requiring approval for changes required for rectification.

   b. Obtain Owner's and Engineer's approval before making such changes.

   c. Provide written details of any changes to be made not requiring approval.

   d. Notify Owner and Engineer in writing before retesting.

   e. Furnish new material and equipment which meets requirements of the Specifications if rejected material and equipment cannot be rectified to satisfaction of Owner and Engineer.

   f. Retest after rectification in presence of Owner or Engineer.

10. Assume responsibility for all costs, including, but not limited to: loss or damage to materials and equipment resulting from testing; retesting; rectification; new material and equipment to replace damaged or non-rectifiable material and equipment; removal, furnishing, transportation, unloading, and installation of replacement material and equipment; and witness of testing by Owner and Engineer including travel, lodging, meals, and payroll.

11. Submit certified test reports which define tests, list results, and are signed by Contractor's representative, and copies of raw data collected during tests. Submission of certified test reports does not relieve Contractor of responsibility for material and equipment meeting requirements of the Contract Documents after installation.

1.03 PRODUCT REQUIREMENTS

A. General

1. Products include new material and equipment incorporated into the Work and may also include existing material and equipment required for reuse. This does not include machinery and equipment used for preparation, fabrication, conveying, installation and erection of the Work.

2. Do not use materials and equipment removed from existing Work Site, except as specifically permitted.

3. Provide complete with accessories, trim, finished, safety guards, and other devices and details need for a complete installation and for the intended use or effect.

4. Provide standard products which have been produced and used successfully on other similar projects for similar applications. Provide products which are likely to be available to Owner in the future for items required for maintenance and repair or replacement Work.

5. Furnish interchangeable components of the same manufacturer, for similar components.

B. Transportation and Handling

1. Transport and handle material and equipment in accordance with manufacturer's instructions.

2. Notify Engineer and Owner in writing upon acceptance of a shipment.

3. Promptly inspect shipments to assure that material and equipment comply with requirements, quantities are correct, and material and equipment are undamaged.

4. Furnish equipment and personnel to handle material and equipment by methods to prevent soiling, disfigurement, or damage.

5. Uncrate equipment and dispose of packing material properly.

C. Storage and Protection

1. Store and protect material and equipment in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive material and equipment in weather tight, climate controlled enclosures.

2. For exterior storage of fabricated material and equipment, place on sloped supports, above ground.

3. Provide for bonded off Site storage and protection when Site does not permit on Site storage or protection.

4. Cover material and equipment subject to deterioration with impervious sheet covering. Furnish ventilation to avoid condensation or potential degradation of material and equipment.

5. Store loose granular materials on solid flat surfaces in a well-drained area. Avoid mixing with foreign matter.

6. Furnish equipment and personnel to store material and equipment by methods to prevent soiling, disfigurement, or damage.

7. Arrange storage of material and equipment to permit access for inspection. Periodically inspect to assure material and equipment are undamaged and are maintained in acceptable conditions.

8. After receipt of material and equipment, assume responsibility for loss and damage including but not limited to breakage, corrosion, weather damage, and distortion.

1.04 WARRANTIES

A. Provide warranties for equipment and material in accordance with Paragraphs 6.19 and 14.03 of the Standard General and Supplementary Conditions, if any.

B. Provide extended or special warranties as indicated in individual Specification sections.

END OF SECTION

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SECTION 01 70 00

EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. This Section specifies general execution requirements and startup/commissioning and performance testing for closeout of the Work. This Section applies to all Specifications and Drawings and provisions of this Section may be supplemented in other sections of Division 01.

B. Certain provisions required by Laws and Regulations may be referenced. Contractor is responsible to determine and obtain applicable Laws and Regulations and to review and interpret the full text of such Laws and Regulations.

C. Section Includes

1.02 OVERALL EXECUTION REQUIREMENTS
Coordination
Existing Conditions
Field Engineering
Cutting and Patching
Electrolytic Corrosion Prevention
Quality Assurance and Control of Installation
Manufacturers' Field Services
Independent Testing
Record Documents

1.03 STARTUP, TESTING, AND COMMISSIONING
Spare Parts
Consumables
Checkout and Starting Systems
Starting, Adjusting, and Balancing
Startup and Commissioning/Performance Testing
Demonstration and Training

1.04 CLOSEOUT REQUIREMENTS

1.02 OVERALL EXECUTION REQUIREMENTS

A. Coordination

1. Conduct preconstruction and pre-installation meetings before commencing certain Work that requires coordination or has special requirements or approvals.

2. Comply with the required Work sequence and coordination as may be specified in Summary of Work and reflect in the Project scheduling.

    a. Comply with working hours specified in Section 00 73 10.

3. Coordinate Work such that Work is completed with minimum disruption to residents and businesses.

4. Coordinate space requirements and installation of Work. Utilize spaces efficiently to maximize accessibility for other installations, maintenance, and repairs.

    a. A primary Site restriction is the width of the streets and volume of traffic within the Project Site which may require complete shut down or partial blocking of the streets during construction. Coordinate with the Fire Department and Police Department.

5. Coordinate Work of the various Specifications with interdependent responsibilities for installing, connecting to, and placing in service, operating equipment.

6. Coordinate related Work at the Site in accordance with Article 7 of the Standard General and Supplementary Conditions, if any.

7. Coordinate completion and cleanup of Work of separate sections in preparation for Substantial Completion and for portions of Work designated for Owner's partial occupancy.

8. After Owner occupancy of premises, coordinate access to Site for correction of defective Work and/or incomplete Work to minimize disruption of Owner's activities.

9. Specific requirements applicable to the Project include the following.

    a. Coordinate with Owner and Engineer prior to performing any Work that will impact the pump station. Refer to Section 01 15 20 for requirements for maintaining operation of facilities.

B. Existing Conditions

1. Paragraph 4.01 of the Standard General and Supplementary Conditions, if any, covers Availability of Lands.

2. Paragraph 4.02 of the Standard General and Supplementary Conditions, if any, covers Subsurface and Physical Conditions.

3. Pursuant to Paragraph 4.04 of the Standard General and Supplementary Conditions, if any, existence and location of Underground Facilities and other utilities and construction indicated as existing are not guaranteed. Before beginning Work investigate and verify the existence and location of Underground Facilities and other utilities and construction.

   a. Contact DIGSAFE at www.digsafe.com or by dialing 811.

   b. Before starting Work in existing manholes or wet wells, test for gas and blow out the manholes.

4. Paragraph 4.05 of the Standard General and Supplementary Conditions, if any, covers Reference Points.

5. Paragraph 4.06 of the Standard General and Supplementary Conditions, if any, covers Hazardous Environmental Conditions at Site.

C. Field Engineering: Not required for the Project.

D. Cutting and Patching

1. Employ skilled and experienced personnel to perform cutting and patching.

2. Submit written request in advance of cutting or alteration which affects:

   a. structural integrity of any element of Project;

   b. integrity of weather exposed or moisture resistant elements;

   c. efficiency, maintenance, or safety element;

   d. safety, traffic, or hazard barriers;

   e. visual qualities of sight exposed elements; and

   f. work of Owner or separate contractor.

3. Execute cutting, fitting, and patching including excavation and fill to complete Work and to:

   a. fit materials together, to integrate with other work;

   b. uncover Work to install ill-timed Work;

c. remove and replace defective or non-conforming Work;

d. remove Samples of installed Work for testing when requested; and

e. provide openings in element of Work for penetration of mechanical and electrical work.

4. Execute Work by methods to avoid damage to other work and which will provide appropriate surfaces to receive patching and finishing.

5. Provide adequate temporary support for Work to be cut.

6. Restore Work with new materials in accordance with requirements of Contract Documents. Use materials identical with original materials where recognized that satisfactory results can be produced.

7. Provide protection from elements for areas which may be exposed by uncovering work.

8. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit. Restore exposed finishes of patched areas; and, where necessary extend finish restoration onto retained adjoining Work in a manner, which will eliminate evidence of patching.

9. Identify any Hazardous Waste, Hazardous Environmental Condition, or hazardous substance exposed during the Work to Owner for decision or remedy in accordance with Paragraph 4.06 of the Standard General and Supplementary Conditions, if any.

10. Cut work by methods least likely to damage Work to be retained and work adjoining. Cut Work with sawing and grinding tools, not with hammering, chopping, or burning tools. Cut masonry and concrete materials with masonry saw or core drill. Do not use pneumatic tools without prior approval. Core drill openings through concrete Work. Adhere to mandatory cutback requirements when saw cutting concrete and roadway openings.

11. Do not cut and patch structural Work in a manner resulting in reduction of load-carrying capacity or load/ deflection ratio.

12. Fit Work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces. Maintain supports to ensure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage and seal voids. For interior work at penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire resistant material, to full thickness of the penetrated element.

13. Do not cut and patch operational or safety-related components that reduce capacities to perform in manner intended. Do not cut and patch Work that reduces visual qualities. Remove and replace unsatisfactory cutting patching as directed by Engineer or Owner.

E. Electrolytic Corrosion Prevention

1. Prevent galvanic action, bimetallic corrosion, anodic or cathodic action, and electrolysis at all electrical grounds and for all galvanic scale (electromotive series or table of oxidation potentials). Do not allow contact of dissimilar metals further apart than 0.35 on the galvanic scale (electromotive series or table of oxidation potentials). The electrode potential of common metals is listed below.

	Electrode Potential Volts (Relative to Hydrogen)
Magnesium	+2.37
Aluminum	+1.70
Zinc+	+0.76
Chromium	+0.56
Iron and Steel	+0.44
Cadmium	+0.40
Nickel	+0.25
Tin	+0.14
Lead	+0.13
Copper	-0.34

2. Unless otherwise indicated, provide dielectric insulators between ferrous and nonferrous pipe and equipment.

F. Quality Assurance and Control of Installation

1. Monitor quality control of Subcontractors, Suppliers, manufacturers, material, equipment, services, Site conditions, and workmanship, to produce Work of specified quality. Conduct field quality control and testing specified.

2. Comply fully with manufacturers' installation instructions, including each step in sequence. If manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

3. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

4. Perform Work using persons qualified to produce workmanship of specified quality.

5. Install field Samples and mockups at the Site as required in Specifications for review. Acceptable Samples and mockups represent a quality level for the Work. Where field Sample or mockup is specified to be removed, clear area after field Sample or mockup has been accepted by Engineer or after Work is complete when mockup is to serve as a control reference.

6. Protect adjacent construction in accordance with Paragraph 6.13 of the Standard General and Supplementary Conditions, if any.

G. Manufacturers' Field Services

1. If required in the Specifications, arrange and pay for material or equipment Suppliers or manufacturers to provide qualified staff personnel (field representative) to perform the following services and services specified. Submit reports of activities, actions taken and test results to Engineer within 10 days of completion.

   a. Observe Site conditions, conditions of surfaces and installation, quality of workmanship.

   b. Report observations and Site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

   c. Assist with field assembly as required.

   d. Furnish, setup, and operate required test equipment and facilities.

   e. Perform and record results of manufacturer recommended inspections and tests, and tests specified for material and equipment.

   f. Be responsible for protection of material and equipment and safety of all personnel during testing.

   g. Perform any other services normally provided by field representative's company.

   h. Instruct operating personnel in proper use of material and equipment.

   i. Instruct and supervise field repairs before acceptance by Owner.

H. Independent Testing

1. Employ and pay for specified services of an independent firm in accordance with Paragraph 13.03 of the Standard General and Supplementary Conditions to perform inspection and testing as may be specified except where responsibility for a specific inspection or test is expressly allocated to Owner in the Specifications or by Laws and Regulations.

2. Reports will be submitted by the independent firm to Owner, in duplicate indicating observations and results of tests and indicating compliance or noncompliance with Contract Documents.

3. Inspection, testing, and source quality control may occur on or off the Project Site.

4. Cooperate with independent firm. Furnish samples of materials, design mix, equipment, tools, storage and assistance as requested.

5. Notify Owner and independent firm 24 hours before expected time for operations requiring services.

6. Make arrangements with independent firm and pay for additional Samples and tests required for Contractor's use.

7. Retesting required because of nonconformance to specified requirements will be performed by the same independent firm if instructed by Owner. Payment for retesting will be charged to Contractor by deducting inspection or testing charges from the Contract Price.

8. Testing or inspecting does not relieve Contractor from performing Work in accordance with requirements of the Contract Documents.

I. Record Documents

1. Provide record documents in accordance with Paragraph 6.12 of the Standard General and Supplementary Conditions, if any, and in accordance with Section 01 15 30.

1.03 STARTUP, TESTING, AND COMMISSIONING

A. Spare Parts

1. Provide spare parts required for construction, startup, testing and commissioning of the Work prior to achievement of Substantial Completion, including spare parts for flushing and consumable supplies such as bolts, nuts, gaskets, filters, insulating tape, etc., normally consumed in the startup, commissioning and testing.

2. If spare parts are to be purchased by Owner as specified, Contractor shall have the right to use the spare parts purchased by Owner provided that such spare parts are replaced prior to Substantial Completion at Contractor's expense. Replacement spare parts, replaced by Contractor, shall be new, unused and identical as the original spare part used.

B. Consumables

1. Provide initial fills of consumables including equipment lubricants, resins, chemicals, desiccants, and fuels. Provide subsequent fills if required during Warranty Period if acts or omissions of Contractor cause such consumables to require replacement.

2. Coordinate with Owner for consumables required.

C. Checkout and Starting Systems

1. Coordinate schedule for startup and operation of various equipment and systems with Owner.

2. Notify Owner 7 days before startup of each major piece of equipment or system, including a staffing request for Owner's operations and maintenance personnel required to adequately and safely support each specific startup and operation activity.

3. Verify that each system or piece of equipment item has been assembled, constructed, or completed in accordance with the Contract and capable of functioning as intended.

4. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, magnetic center alignment, belt tension, control sequence, or other conditions which may cause damage.

5. Verify that each piece of equipment or system has successfully completed construction testing and cold commissioning, including hydrostatic testing, loop checks, relay checks, calibration, and continuity checks and that all tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

6. Verify wiring and support components for equipment are complete and tested.

7. Execute startup under supervision of responsible manufacturers' representative or Contractor's personnel in accordance with manufacturers' instructions utilizing Owner's qualified operations and maintenance staff trained by Contractor.

8. When specified in individual Specification Sections, require manufacturer to provide field representative to be present at Site to inspect, check and approve equipment or system installation before startup, and to supervise placing equipment or system in operation.

D. Adjusting and Balancing

1. Supply necessary equipment, material, construction power, and consumables (except for those provided by Owner) needed to startup and fully test the Work and replenish the same until Substantial Completion is achieved. Contractor may utilize Owner's operating spare parts, such use requiring timely replacement at Contractor's expense.

2. Coordinate as required for conduct of independent testing.

3. Perform specified and required adjusting and balancing concurrently to the maximum extent possible on individual equipment and systems and prior to startup and commissioning/performance testing.

E. Startup and Commissioning/Performance Testing

1. Conduct startup and commissioning/performance tests to demonstrate the Work meets the requirements of the Contract Documents, satisfies the Owner's requirements, and is in accordance with Paragraph 14.04. of the Standard General and Supplementary Conditions, if any. Conduct testing in accordance with individual Specifications and Section 01 91 15 Startup, Commissioning and Testing.

2. Prepare and submit a written startup and commissioning/performance testing procedures no later than 60 days prior to start of testing for review and final test procedures no later than 30 days prior to start of testing. Submit a staffing request for Owner's operations and maintenance personnel.

3. Calibrate test equipment and instrumentation on Site or provide acceptable certificate of calibration conducted within 30 days of testing.

4. Complete functional testing prior to initiating the startup and commissioning/performance testing as specified.

5. Complete specified startup and commissioning/performance tests prior to Substantial Completion. Owner and Engineer will witness Performance Testing. Notify Owner and Engineer in writing at least 7 days prior to starting any startup and commissioning/performance testing. Coordinate for witnessing of tests by required regulatory representatives.

6. Submit written test reports.

F. Demonstration and Training

1. Provide formal demonstration and training of Owner's personnel as specified in individual Specifications.

1.04 CLOSEOUT REQUIREMENTS

A. Substantial Completion shall have been achieved when the following has been completed and the requirements of Paragraph 14.04 of the Standard General and Supplementary Conditions, if any, have been met.

1. Work is complete, systems are successfully operating, and final testing has been successfully completed.

2. A full inventory of the spare parts and special tools purchased by the Owner are replenished and in the custody of the Owner.

3. The Site has been restored to the satisfaction of the Owner.

4. An inspection of the Work has been completed by the Engineer and the Owner.

5. An updated Punch List is provided.

6. The Contractor's written warranty and guarantee has been submitted as required by Paragraph 6.19.D. of the Standard General and Supplementary Conditions, if any.

7. A Certificate of Substantial Completion has been provided in accordance with Paragraph 14.04.C. of the Standard General and Supplementary Conditions, if any.

B. The Contractor shall have sole care, custody, and control of the Work until achievement of Substantial Completion. During the period between Substantial Completion and the date for Final Completion, Contractor shall be given access to correct items on the Punch List and achieve Final Completion.

C. The date of achieving Substantial Completion is the date set forth in the Certificate of Substantial Completion that is accepted and signed by the Owner.

D. Final Completion shall have been achieved when the Work is complete, the requirements of Paragraphs 14.06 and 14.07 of the Standard General and Supplementary Conditions, if any, have been met, and when the following is complete.

1. Substantial Completion has been achieved and liquidated damages for failure to meet Substantial Completion Date have been paid.

2. All Work including Punch List Items has been completed.

3. Final cleaning has been conducted and Contractor equipment and supplies including waste materials have been removed from the Site and legally disposed of.

4. A full set of record documents have been submitted as specified in subparagraph 1.02.I. above and Contractor's written warranty and guarantee has been resubmitted if adjusted.

5. Inspections required by Laws and Regulations are complete. Certificates and permits to occupy and operate have been issued if required.

6. Spare parts, maintenance and extra materials have been delivered in quantities specified to Project Site and stored as directed.

7. A request for final inspection in accordance with Paragraph 14.06 of the Standard General and Supplementary Conditions, if any, has been submitted to the Engineer and the inspection has been completed and the results accepted by the Owner.

8. A Final Application for Payment has been submitted to the Engineer identifying total adjusted Contract Price, previous payments, and balance due along with required documentation in accordance with Paragraph 14.07.A. of the Standard General and Supplementary Conditions, if any.

END OF SECTION

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SECTION 01 91 15

STARTUP AND COMMISSIONING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Startup and commissioning of the systems for the Devonshire Road Pump Station Improvements.

B. A system is defined as an arrangement of items of equipment, components, piping, wiring, materials, or incidentals so related or connected as to form a functional and operational unit.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION

3.01 SYSTEM STARTUP AND DEMONSTRATION REQUIREMENTS

A. Pre-Startup Requirements

1. Prior to startup, undertake the following procedures, in the order listed.

a. Ensure required written statements and/or guarantees from manufacturers of individual Specification sections comply with Contract Documents. Use a checklist to identify such requirements, by Specification section and submit a copy of completed checklist to the Engineer with manufacturers' written statements and/or guarantees.

b. Ensure Work is complete before startup of any unit or system. Certify to Owner that specifically services or respective equipment manufacturers' representative required by individual Specifications have been performed in accordance with Contract Documents.

c. Ensure systems are tested hydraulically, mechanically, and electrically. Ensure systems requiring calibration, commissioning, and balancing are fully certified as complete in performance in accordance with Contract Documents. Ensure required tagging, identification, and stenciling is complete.

d. Schedule startup a minimum of 30 days prior, with written notice issued, but not limited to: Owner, Engineer, Subcontractors, and applicable regulatory agencies.

e. Provide labor, supervision, utilities, chemicals, equipment, tools, materials, vehicles and other items necessary to startup, operate, and demonstrate the system.

f. Provide gauges, meters, recorder and monitors as required by the Engineer to supplement or augment the instrumentation system provided under this Contract to properly demonstrate that equipment fully satisfies the requirements of the Contract Documents. Select specific devices employed for the purpose of measuring the performance of the facility's equipment and systems to provide a level of certainty consistent with the variables to be monitored. Provide that instruments are recently calibrated, and be prepared to demonstrate, through recalibration, the certainty of instruments employed for testing purposes. Perform calibration procedures per applicable standards of ASTM, ISA and IEEE. The adequacy of gauges, meters, recorders and monitors are subject to review of the Engineer.

g. Provide sign off forms for each item of mechanical, electrical and instrumentation equipment provided or installed and include provisions for recording relevant performance data for original testing, and not less than 3 retests. Provide separate sections on the form to record values for pre-operation checkout, initials of representatives of equipment manufacturers, Contractor and Engineer.

h. Maintain a master file of equipment sign off forms and make available for inspection by the Engineer. Upon completion of equipment testing, submit the original and two copies of the sign off forms for each equipment item.

B. System Startup and Demonstration

1. Startup, operate and demonstrate specified performance of each item of equipment and each system at full operation without interruption of equipment or system or need of adjustment or repair to the satisfaction of the Engineer.

2. During startup of equipment, provide knowledgeable and experienced person(s) to instruct Owner's designated personnel on the operation and maintenance of each system in addition to services provided by equipment manufacturer's authorized representative(s) prescribed by individual Specifications. Provide instructions during the startup period in the form of a comprehensive "overview"; do not simply repeat previous operation and maintenance instructions. Provide a minimum of 4 hours of operation and maintenance instructions on each system per the Specifications.

3.02 EQUIPMENT STARTUP & PERFORMANCE TEST PROTOCOL

A. Conduct startup in the following order.

1. Equipment pre-startup check

2. Equipment and performance testing

3. Manufacturers' equipment testing

B. Equipment Pre-Startup

1. Check out each item of equipment in the presence of the Engineer to demonstrate proper installation, functioning and ready for equipment startup and performance testing.

2. Minimum requirements include, but are not limited to, the following.

a. Coordinate with electrical and Mission Communications for connections, terminations, controls, configuration, and programming, as required.

b. Ensure equipment is properly installed, painted, leveled, wired and/or insulated.

c. Ensure piping is properly installed and valving is properly set.

d. Ensure piping is cleaned and pressure tested, as required.

e. Ensure equipment is properly lubricated.

f. Ensure safety related accessories are properly installed.

g. Bump or momentarily jog equipment to establish operation and proper rotation.

3. Arrange for equipment manufacturers to be present, or verify that these procedures may be done without the manufacturer's representatives being present.

C. Equipment Startup

1. Prior to testing any equipment, obtain written certification from the manufacturer that the equipment is properly installed, calibrated and ready for safe and efficient operation as intended by the Engineer and manufacturer.

2. Thoroughly clean and flush equipment and associated piping, channels, basins, and wetwells prior to startup and testing of any item of equipment.

3. Startup and operate each item of equipment, with assistance from the manufacturer's factory trained service engineer and in the presence of the Engineer, to demonstrate equipment performs according to the requirements of the Specifications to ensure equipment is ready for performance testing.

D. Performance Tests

1. General

a. Coordinate with electrical systems and Owner's Mission contractors for performance testing.

b. Make full tests at the Site on each item of equipment after it has been properly installed, started and certified ready for operation to demonstrate that each item of equipment will operate properly by itself and in conjunction with other facility equipment in accordance with the Specifications.

c. Furnish necessary labor, tools, equipment, power, chemicals and clean water, to perform field tests to determine that the supplied equipment, including controls and alarms, meet hydraulic, electric mechanical and performance requirements in accordance with the Specifications.

d. Repeat incomplete and/or unsuccessful tests to the satisfaction of the Engineer.

2. Pumps

a. Determine maximum pumpage.

b. Ensure pump rate falls on pump curves.

c. Record the following readings on each pump.

1) Test Flow Rate and TDH during Test

2) Amperes per phase, at the Test Flow Rate and TDH

3) Voltage each phase, at the Test Flow Rate and TDH

4) HP input to motor, at the Test Flow Rate and TDH

d. Determine efficiency of pumping units at test and design conditions.

e. Record maximum ampere and voltage readings of each motor and determine that they compare to the nameplate data.

f. Verify proper operation of valves.

g. Verify pump speed.

3. Process Equipment, Instrumentation, and Controls

a. Calibrate and/or verify calibration and proper operation and function of all process and analytical instruments, and documents results, for the following.

1) Flow measurement

2) Indicating controllers

3) Indicators

4) Miscellaneous equipment

4. Electrical

a. Verify proper operation and function of electrical equipment and instruments, and document results, for the following.

1) Variable Frequency Drives

2) Vendor Pump Control Panel and local alarms

3) Diesel Gas Generator

4) ATS

5) Enclosure Lighting

6) Enclosure GFCI Receptacles

7) Enclosure HVAC Equipment

5. Mission Unit

a. Coordinate with Mission Communications to configure, program, calibrate and/or verify proper operation and callout functionality for Mission unit in conjunction with monitored equipment.

E. Manufacturers' Training

1. Comply with requirements in Specifications for manufacturers' training.

2. No training can be conducted until the Owner has received approved manufacturers' operation & maintenance manuals.

3. Owner will not accept any item of equipment prior to receiving approved manufacturer training for the equipment. This applies only to equipment requiring manufacturers' training in accordance with the Specifications.

4. Conduct training in addition to and exclusive of startup and performance testing.

5. Engineer shall approve the completeness of training and provide written verification of manufacturers' equipment training.

END OF SECTION

SECTION 02 41 14

SELECTIVE SITE DEMOLITION AND RESTORATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide Site demolition including clearing, stripping or ordinary excavation of existing bituminous or cement concrete pavements, soils, foundations, bituminous or cement concrete curbs, bituminous or cement concrete sidewalks, grassed areas, demolition, dismantling, replacement and restoration Work, stacking of reusable and disposal of waste and surplus materials and tree protection and removal in accordance with this Section and applicable reference standards listed in Article 1.03.

B. Related Requirements

1. Section 31 10 00 – Site Clearing

2. Section 32 90 00 – Planting

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. MassDOT

a. Standard Specifications for Highways and Bridges, Supplemental Specifications, and Construction Details

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Closeout and maintenance material submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 GENERAL

A. Perform selective Site demolition in accordance with MassDOT Section 101.

B. Comply with General Requirements for temporary construction controls, protections, and waste disposal.

1. Ensure against damage or injury to buildings, occupants, and adjacent property from falling debris or other causes. Avoid damage to adjacent areas, facilities, and appurtenances.

2. Maintain free and safe passage to and from Site.

3. Legally dispose of waste, surplus and unsatisfactory materials including bituminous or cement concrete, debris, rails and ties, common excavation, cold planing, and reclamation immediately as it accumulates during clearing, grubbing, stripping, demolition, and other Site preparation. Burying is not allowed.

C. Mark trees, plantings and other items to be removed, trimmed, cut, or removed and preserved. Inspect items with Engineer prior to start of Work. Do not remove or trim unmarked items unless approved by Engineer. Refer to Section 31 10 00.

3.02 SITE DEMOLITION

A. Clear Site of construction debris and waste materials, including grass, bushes, trees, broken concrete, fencing, pipes, lumber and steel pieces, rags and plastics, within limits of Work as shown on Drawings or as directed.

B. Strip or excavate existing bituminous or cement concrete pavements, soils, foundations, bituminous or cement concrete curbs, bituminous or cement concrete sidewalks, and grassed areas, as shown on Drawings.

C. Remove and stack fencing, lamp posts, letter boxes, signs, guardrails, bike racks, poles and other usable materials to be reinstalled.

D. Demolish and remove existing bituminous pavement, bituminous and concrete walkways, curbing, grass borders and landscaping, bushes, shrubs and vegetation only as necessary. Remove existing obstructions and debris, cut trees, bushes, root stumps, waste stones, wood, lumber, metal, plastic, and other unsuitable materials, above, at, or below grade that may interfere with or obstruct the Work, whether or not shown on Drawings.

E. Remove and stockpile top soil, curb stones, utility castings and other materials for reuse as shown or directed by Engineer.

F. Stockpile recovered materials acceptable to Engineer to be reused on Project and protect against damage or deterioration.

G. Do not cut, remove, destroy, or trim trees, bushes, and/or shrubs unless specifically marked or permitted. Do not remove tree branches using excavating equipment. Provide that required trimming is performed by an arborist licensed in the state where the Project is located.

1. Protect trees or vegetation outside limits of Work area.

2. Tree Removal (4-48 inches in diameter)

a. Cut existing trees and expose by excavation, remove or cut, as required, tree stumps and root systems as shown on Drawings and as directed. Remove and legally dispose of tree stumps, roots, organic matter and unsuitable materials.

b. Excavation around tree not to exceed width of sidewalk.

c. Depth of excavation for stump removal not to exceed 5 feet.

d. Depth of excavation for removal of tree root system not to exceed 2 feet.

e. Cut clean and remove root system encountered within limits of sidewalk width as determined by Engineer. Paint cut surfaces of remaining detached roots with stump rot. Clean and paint tree roots still attached to trunk with 2 coats of approved chemical root guard.

f. Transport and stack existing tree grates in good condition, not needed for Project, or legally dispose of as directed by Engineer.

H. Protect integrity of remaining structures, appurtenances and equipment during demolition, removal and alteration to existing structures, appurtenances, utility pipes, castings, fences, walkways, posts, stairs and other physical features.

I. Maintain slopes longitudinally and laterally to ensure proper and continuous drainage. Field adjust sidewalk and roadway gutter grades at driveways and side street intersections to be consistent with existing drainage pattern and provide for an appropriate transition between new and existing side streets and driveway pavement surfaces at intersections.

J. If cobblestones are encountered, carefully stack excavated cobblestone.

K. Leave abandoned underground piping in place, plug or cap and fill with flowable control density fill. Remove or cut abandoned underground piping castings a minimum 12 inches below finished surface and area backfilled.

L. Cut sections of piping to be removed to nearest solid support or provide appropriate new supports and cap remaining ends before backfilling, unless noted on Drawings or directed by Engineer.

M. Cut openings in existing masonry Work to provide for a suitable bond. Clean, square and plumb openings for installation of new Work. Thoroughly clean cut surfaces of loosened materials.

3.03 SAWCUTS IN EXISTING PAVEMENTS AND SIDEWALKS

A. Neatly saw cut edges of excavations in existing pavements and sidewalks along either a straight line or design curved line as shown in Drawings. Ragged, uneven edges are not acceptable.

B. Saw cut existing pavement through its full depth or to elevation of abutting pavement subgrade, whichever is less, at joints between existing and proposed pavements, and at utility trenches through existing remaining pavement. Provide a uniform, vertical surface for pavement joint with existing pavement.

C. Neatly saw cut edges that become broken, ragged or undermined with minimum disturbance to remaining pavements or sidewalks, prior to placement of abutting pavement.

D. In areas where existing concrete sidewalk abuts a building, wall or storefront, and sidewalk is to be reconstructed or removed, saw cut existing sidewalk a minimum of 6 inches from building wall or storefront, unless otherwise directed by Engineer.

E. Spray or paint saw cut surfaces with a uniform thin coat of RS-1 asphalt emulsion immediately before placement of hot mix asphalt material against surface.

3.04 REPAIR, REPLACEMENT AND RESTORATION

A. Match materials of repair or restoration to existing adjacent surfaces in finish and texture as closely as possible. Make joints between new and existing Work inconspicuous.

B. Replace or restore items damaged, dislocated or dismantled such as field stone masonry walls, fences, lamp posts, letter boxes, masonry boundary walls, City signs, poles, bollards, curb stones, markers, trees, bushes, grassed areas, walkways, stairs, steps, benches, outside lighting and other amenities and physical features designated to remain, to original condition.

C. Re-plant trees designated on Drawings in accordance with Section 32 90 00.

3.05 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.06 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 03 01 05

CONCRETE REPAIR

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Repair new concrete when permitted by Engineer and fill form tie holes according to Section 03 30 20, and repair deteriorated concrete areas indicated on Drawings and in accordance with this Section and applicable reference standards listed in Article 1.03.

B. Related Requirements

1. Section 03 30 20 - Concrete Placing, Curing and Finishing

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. American Association Of State Highway And Transportation Officials (AASHTO)

a. AASHTO T 277 Standard Method of Test for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

2. ASTM International (ASTM)

a. ASTM C78 Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

b. ASTM C109 Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)

c. ASTM C496 Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens

d. ASTM C882 Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear

e. ASTM C884 Thermal Compatibility between Concrete and Epoxy-Resin Overlay

f. ASTM C1202 Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

g. ASTM G109 Determining the Effects of Chemical Admixtures on the Corrosion of Embedded Steel Reinforcement in Concrete Exposed to Chloride Environments

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data

1. Trowel-grade polymer modified portland cement repair mortar

2. Non-sag polymer modified portland cement repair mortar

3. Reinforcing steel primer

C. Notarized certificate stating that repair material meets the specified requirements and the manufacturer's current printed product literature.

D. Closeout and maintenance material submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1. Deliver products in original, unopened containers with the manufacturer's name, labels, product identification, and batch numbers.

2. Store in accordance with manufacturer recommendations.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

1. Take precautions to avoid damage to surface due to mixing and handling of the specified repair material near area of Work.

PART 2 – PRODUCTS

2.01 MORTAR

A. Comply with applicable reference standards listed in Article 1.03.

B. Performance/Design Criteria

1. Mixed Properties

a. Application time: approximately 15 minutes.

b. Finishing time: 20-60 minutes.

c. Color: concrete gray.

2. Cured Properties

a. Compressive Strength (ASTM C109)

1) 1 day: 3,000 psi minimum.

2) 28 day: 7,000 psi minimum.

b. Splitting Tensile Strength (ASTM C496)

1) 28 day: 750 psi minimum

c. Flexural Strength (Modulus of Rupture, ASTM C78)

1) 28 day: 2,000 psi minimum.

d. Bond Strength (ASTM C882)

1) 28 day: 2,200 psi minimum.

e. Thermal Compatibility (ASTM C884)

1) Passes test

f. Permeability (ASTM C1202, AASHTO T 277)

1) 28 day: approximately 500 coulombs.

g. Cracked Beam Corrosion Tests (ASTM G109)

1) Reduced corrosion rates: 63 percent versus control specimens.

C. Acceptable level of quality: equivalent to products manufactured by Sika Corporation meeting the specified performance requirements.

1. Trowel-grade mortar for horizontal surfaces: SikaTop 122 Plus.

1. Non-sag mortar for vertical and overhead surfaces: SikaTop 123 Plus.

2. Steel reinforcement primer: Sika Armatec 110 EpoCem.

2.02 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements. Comply with applicable reference standards listed in Article 1.03.

PART 3 – EXECUTION

3.01 GENERAL

A. Comply with applicable reference standards listed in Article 1.03.

B. Do not apply material in inclement weather or if inclement weather is imminent.

C. Condition product as recommended by manufacturer.

3.02 SURFACE PREPARATION

A. Mechanically prepare areas to be repaired so they are clean, sound and free of contaminants. Remove loose and deteriorated concrete by mechanical means. Remove dirt, oil, grease, and bond-inhibiting materials from the surface.

B. Except where tie holes are filled, saw cut perimeter 1/8 inch minimum when a neat mortar is to be applied, and 1-inch minimum when an extended mortar is to be applied.

C. Prepare concrete substrate to obtain a minimum surface profile of 1/16 inch in depth with a new aggregate fractured surface using steel shot blasting, abrasive blasting, or water jetting. Do not use scabblers, bush hammers, or pneumatic hammers. Provide that the area to be repaired is not less than 1/8 inch in depth.

D. Prepare substrate to saturated surface dry condition with no standing water.

E. Steel Reinforcement Primer

1. Where reinforcement with active corrosion is encountered, sandblast to remove contaminants and rust, pressure wash, and apply primer.

2. Determine section loss and splice new reinforcement where there is more than 15 percent to 25 percent loss, as directed by Engineer. If half or more of the diameter of the bar is exposed, chip out 1/2 inch minimum behind the bar.

F. Treat cracks in the substrate in the area of repair as directed by Engineer.

3.03 MIXING AND APPLICATION

A. Mix and apply in strict accordance with manufacturer's instructions and adhere to limitations and cautions.

B. Trowel-Grade Polymer Mortar

1. Pour entire Component A into mixing container. Add entire Component B while mixing. For extended mix, introduce 3/8-inch coarse aggregate at desired quantity. Mix to uniform consistency, maximum 3 minutes.

a. Addition rate not to exceed 42 pounds per bag.

b. Aggregate: non-reactive, clean, well-graded, saturated surface dry, with low absorption/high density.

2. Scrub mortar into substrate, filling pores and voids. Force material against edge of repair, working toward center. After filling repair, consolidate, then screed. Allow mortar or concrete to set to desired stiffness and finish with wood or sponge float for a smooth surface.

a. Minimum application thickness: 1/8-inch for a neat mortar; 1 inch if extended.

b. Maximum application thickness in a single lift: 1 inch for a neat mortar; 3 inches if extended.

c. Where multiple lifts are required, score top surface of the preceding lift to produce a roughened surface. Allow preceding lift to reach final set prior to applying the next lift.

C. Non-Sag Polymer Mortar

1. Pour entire Component A into mixing container. Add entire Component B while mixing. Mix maximum 3 minutes to uniform consistency.

2. Scrub mortar into substrate, filling pores and voids. Force material against edge of repair, working toward center. After filling repair, consolidate, then screed. Allow mortar or concrete to set to desired stiffness and finish with wood or sponge float for a smooth surface.

   a. Minimum application thickness: 1/8-inch.

   b. Maximum application thickness in a single lift: 1-1/2 inches.

   c. Where multiple lifts are required, score top surface of preceding lift to produce a roughened surface. Allow preceding lift minimum 30 minutes to reach final set prior to applying the next lift.

D. Curing

1. Moist cure with wet burlap and polyethylene using a fine mist of water or water based compatible curing compound. Do not use curing compounds for curing between successive lifts. Do not use solvent-based curing compounds. Commence moist curing immediately after finishing. Protect newly applied material from direct sunlight, wind, rain, and frost.

3.04 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements. Comply with applicable reference standards listed in Article 1.03.

B. Manufacturer Field Services

1. Furnish the services of a qualified manufacturer's field representative prior to commencement of application to provide instruction, demonstrate proper application and inspection procedures, and to inspect the finish of the prepared surfaces prior to application.

3.05 CLEANING

A. Leave finished Work and work area in a neat, clean condition without evidence of spillovers on adjacent areas.

3.06 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 03 11 00

CONCRETE FORMING

PART 1 – GENERAL

1.01 SUMMARY

A. Provide materials, tools, equipment and labor required for the design, preparation and cleaning, construction, and removal of concrete formwork, and installation of concrete embedments furnished under other sections, for completion of Work in accordance with this Section and applicable reference standards listed in Article 1.03.

B. Related Requirements

1. Section 03 30 20 – Concrete Placing, Curing and Finishing

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. American Concrete Institute International (ACI)

a. ACI 117 Specifications for Tolerances for Concrete Construction and Materials and Commentary

b. ACI 301 Specifications for Structural Concrete

c. ACI 347 Guide to Formwork for Concrete

2. ASTM International (ASTM)

a. ASTM C31 Standard Practice for Making and Curing Concrete Test Specimens in the Field

b. ASTM C39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

3. U.S. Army Corps of Engineers (USACE)

a. COE CRD-C 572 Corps of Engineers Specifications for Polyvinylchloride Waterstops

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data

1. Form Liners

2. Form Ties

3. Form Release Agent

C. Samples

1. Form Liners

D. Manufacturer's Instructions

1. Form Liners

2. Form Ties

3. Form Release Agent

4.

E. Closeout and maintenance material submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 MATERIALS

A. General

1. Comply with applicable reference standards listed in Article 1.03.

2. Formwork shall conform dimensionally to the concrete Work as shown on the Drawings. To minimize the number of panel joints, formwork panels shall be of the largest practicable sizes.

3. Undamaged smooth form facing materials such as plywood, hardboard, metal, and plastic, that will produce a smooth form finish, shall be used. Formwork shall not result in fins or offsets exceeding 1/8 inch. If used, aluminum forms with un-oxidized surfaces shall be pretreated with a paste made of calcium hydroxide and water, followed by water rinsing, repeated until hydrogen bubbles do not form.

B. Form Release Agent

1. Form release agent shall be non-grain raising, non-staining, and shall not leave a residue on the concrete nor adversely affect bonding of materials to be applied.

C. Form Ties

1. General Requirements

a. Form ties shall be adjustable length, sized to withstand construction loads, and upon removal shall prevent concrete spalling. Ties shall have break back indentation.

b. Plastic cones: form tie assembly with cone-shaped depressions at the concrete surfaces with break back ties. The portion of the tie remaining embedded in the concrete upon removal shall be equal to the depth of the cone specified.

c. Neoprene washers: flat washer sized to fit tightly on tie wire and positioned at the center of the tie wire.

d. Tie systems that include plug style waterstops inserted into tie holes after removal of forms are not permitted.

2. All other Work

a. Plastic cones: 1 inch diameter by 1inch deep (Standard)

b. Neoprene washers: not required, unless noted otherwise on Drawings.

D. Form Liners

1. Form liners shall be as manufactured by Greenstreak, Doran, Scofield, or equal, type as shown on the Drawings.

2.02 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements. Comply with applicable reference standards listed in Article 1.03.

PART 3 – EXECUTION

3.01 GENERAL

A. Comply with applicable reference standards listed in Article 1.03.

B. Design, erect, shore, brace, and maintain formwork in accordance with ACI 301 to support all loads, including construction loads, until the concrete structure can support such loads.

3.02 CONSTRUCTION

A. Tolerances: per ACI 117.

B. Form Alignment

1. At locations where continuous surfaces are formed in successive units, forms shall be tightly fitted over the hardened concrete surface to obtain accurate surface alignment and to prevent leakage of mortar and the formation of fins, ridges, and other defects.

C. Chamfered Edges

1. Exposed concrete corners shall be formed with beveled strips to provide 3/4 inch chamfers, unless otherwise shown, specified, or directed by the Engineer.

2. Where concrete walls, columns, and beams abut masonry walls, the chamfer shall be omitted.

3. Where masonry walls are flush with the face of supporting concrete curbs, the chamfer shall be omitted.

4. Chamfering by grinding is prohibited.

D. Openings

1. Form openings in concrete where required for other Work. Upon failing to form such openings, provide them in a manner approved by the Engineer at no additional cost to the Owner.

2. Provide 6-inch PVC waterstop at the perimeter of such openings required to be watertight.

3. Except as otherwise specified, all such openings shall be filled with concrete after the Work to be installed therein is complete.

E. Cleanouts and Access Panels

1. Provide temporary openings to facilitate cleaning and inspection prior to concrete placement, including at the bottom of wall forms. Cleanout openings are not permitted in exposed concrete, concrete exposed to view upon completion of the Work, whether or not it is painted, without the approval of the Engineer.

2. Remove refuse, sawdust and shavings and broom clean forms before concrete placement.

F. Form Release Agent

1. Coat forms with approved form release agent before placement of reinforcing steel. Do not apply form release agent at locations of monolithic construction joints, which are construction joints with all the reinforcement continuous through the joint. Excess agent applied to the forms, and on the reinforcing steel and other surfaces requiring a concrete bond, shall be removed.

2. Forms for unexposed surfaces may be thoroughly wetted in lieu of the approved form release agent immediately before concrete is placed. However, form release agent shall be used in freezing weather.

3.03 INSTALLATION OF EMBEDDED ITEMS

A. General

1. Coordinate the setting of anchor bolts, thimbles, inserts, wall pipe, sleeves, and other embedded items. Before placing concrete, ensure that all items are accurately located and firmly secured against displacement.

2. All items shall be thoroughly cleaned and free of loose rust, mill scale, dirt, grease, etc. Wood used for removable keys shall be thoroughly dampened before concrete is placed against it.

B. Electrical Conduit

1. Electrical conduit may be embedded in concrete provided the following conditions are met.

a. Outside diameter of conduit shall not exceed 1/3 of concrete thickness.

b. Do not place conduit closer than 3 diameters on center.

c. Conduit may not significantly impair the strength of the construction.

d. Do not embed conduit in structural concrete slabs less than 4 inches thick.

e. Only 2 conduits may cross at any point. The sum of the outside diameter of the crossing conduits shall not exceed 1/3 of the concrete thickness.

f. A 1-1/2 inch minimum concrete cover shall be provided for conduits in structural slabs.

g. Do not locate conduit between bottom of reinforcing steel and bottom of slab.

h. Conduit is not permitted in beams, girders, and columns without the approval of the Engineer.

i. Do not embed aluminum conduit in concrete.

j. Install conduit so that cutting, bending, or displacement of reinforcement from its proper location is not necessary.

2. Notify Engineer of any embedded conduits not installed according conditions specified a minimum of 24 hours prior to concrete placement. Reposition noncompliant conduit placements or remove to satisfaction of Engineer and Owner.

3.04 REMOVAL

A. Form Removal

1. Form removal per ACI 347, as modified.

2. Remove forms while ensuring the safety and serviceability of the structure. Forms or shoring for suspended members may not be removed until members are of sufficient strength to safely support their own weight and the weight thereon.

3. Newly unsupported portions of the structure may not be subjected to heavy construction or material loading. Provide additional shores or re-shores as required to support the members during the construction period.

4. Prevent spalling of concrete surfaces.

5. When forms are removed before the specified curing period as specified in Section 03 30 20 is complete, take measures to continue curing and continue providing thermal protection for the concrete.

6. Forms may be removed when the cumulative time during which the temperature of the air surrounding the concrete is above 50 degrees F are as follows.

    a. Parts of the work not supporting the weight of the concrete: 24 hours.

    b. When design superimposed load is less than the self-weight.

        1) Slabs

            a) Clear span less than 10 feet: 4 days

            b) Clear span 10 feet to 20 feet: 7 days

            c) Clear span more than 20 feet: 10 days

    c. When design superimposed load is more than the self-weight

        1) Slabs

            a) Clear span less than 10 feet: 3 days

            b) Clear span 10 feet to 20 feet: 4 days

            c) Clear span more than 20 feet: 7 days

    d. Alternatively to the stripping times specified, additional concrete cylinders shall be made using representative concrete, witnessed and approved by the Engineer, and tested at no additional cost to the Owner. Such specimens shall be field cured in accordance with ASTM C31 under conditions that are not more favorable than the most unfavorable conditions for the portions of the concrete that the test specimens represent. The supporting forms and shores may be removed when the concrete strength as tested per ASTM C39 is a minimum of 70 percent of the specified design strength, as determined by the field-cured cylinders according to ACI 301.

B. Tie Holes

1. Filling of form tie holes and concrete finishing as specified in Section 03 30 20.

3.05 CLEANING AND REPAIR OF FORMS

A. Inspect, clean, and repair parts of forms reserved for reuse. Discard any parts dented, deformed, or rendered unfit for reuse.

3.06 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements. Comply with applicable reference standards listed in Article 1.03.

3.07 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 03 16 00

CONCRETE SPECIALTIES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide materials, tools, equipment, and labor for the construction of concrete specialties as specified, shown on Drawings, and in accordance with this section and applicable reference standards listed in Article 1.03.

2. Epoxy adhesive for installing drilled and epoxy rebar is specified.

3. Post-installed expansion anchors and adhesive anchoring systems are specified in Section 05 50 00.

B. Related Requirements

1. Section 03 30 00 – Cast-In-Place Concrete

2. Section 03 30 20 – Concrete Placing, Curing and Finishing

3. Section 05 50 00 – Metal Fabrications

4. Section 26 05 43 – Underground Ducts and Raceways for Electrical Systems

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. American Concrete Institute (ACI)

a. ACI 355.2 Qualification of Post-Installed Mechanical Anchors in Concrete

b. ACI 355.4 Qualification of Post-Installed Adhesive Anchors in Concrete

2. ASTM International (ASTM)

   a. ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

   b. ASTM A1064 Standard Specification Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

   c. ASTM C1107 Standard Specification for Packed Dry, Hydraulic-Cement Grout (Non-shrink)

   d. ASTM D4832 Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders

3. ICC Evaluation Service (ICC-ES)

   a. ICC-ES AC308 Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data

1. Non-Shrink Grout

2. Epoxy Adhesive (for drill and epoxy rebar)

   a. ICC-ES report for manufacturer's specific product

   b. Epoxy ultimate bond strength

   c. Manufacture's chart for embedment to develop yield strength and tensile strength of ASTM A615, grade 60, rebar sizes #3 thru #11.

   d. Storage requirements

   e. Gel and cure times as a function of temperature

   f. Installation temperature requirements for cartridges and base material

   g. Drilling method (diamond drill bit shall be prohibited)

h. Drill bit diameter and depth of hole for rebar sizes

i. Hole cleaning procedure and required condition of hole

j. Requirements for discarding initial discharge to ensure proper mixing

k. Hole filling procedure

l. Time period when anchor cannot be contacted or otherwise disturbed

C. Design Data and Test Reports

1. Concrete for concrete fill and duct banks.

a. Submittals as required in Section 03 30 00.

2. Controlled Low Strength Material

a. Submittals as required in Section 03 30 00.

b. Both 28-day and 90-day compressive strength test results.

D. Certifications

1. ACI/CRSI Adhesive Anchor Installer Certification or equivalent as approved by the Engineer, for installation of adhesive anchors horizontally or upwardly inclined to resist sustained tension loads.

E. Shop Drawings

1. Reinforcement

F. Closeout and maintenance material submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Qualifications: per Division 01 General Requirements for anchor installation and as follows.

1. Anchors shall be installed by qualified personnel trained to install adhesive anchors.

2. Adhesive anchors shall be installed in strict accordance with the Manufacturer's Printed Installation Instructions (MPII).

3. Each installer shall have the MPII in their possession at all times.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 GENERAL

A. Comply with applicable reference standards listed in Article 1.03.

2.02 GROUT

A. Type: non-metallic, cementitious non-shrink grout meeting ASTM C1107, grade C.

1. Dayton Superior Sure-Grip High Performance Grout
2. L&M Construction Chemicals, Inc. Crystex or Premier
3. U.S. Grout Company Five Star Grout
4. Or equal

2.03 CONCRETE FILLS

A. Concrete: per Section 03 30 00, except with 28-day design compressive strength of 4,000 pounds per square inch, and maximum water-to-cementitious ratio of 0.45.

B. Concrete fills of minimum thickness less than 2-1/4 inches, and those screeded into place by process equipment, shall have a 1/2 inch maximum size aggregate.

2.04 DUCTBANKS

A. Underground electrical duct banks: concrete encased. Concrete shall be as specified in Section 03 30 00, except it shall have a 3/8 inch maximum aggregate size and a minimum 28-day compressive strength of 3,000 pounds per square inch.

B. Duct banks shall be reinforced as detailed where crossing under roads, driveways, parking areas, all areas subject to vehicular traffic, and whereas shown or specified in the Contract Documents. Reinforcement shall extend a minimum of 4 feet beyond the specified areas.

C. Coordinate red shake-on red pigmented dye, acid stains, or integral coloring as required in Section 26 05 43.

2.05 CONTROLLED LOW STRENGTH MATERIAL

A. A rigid-setting mixture of portland cement, sand, and water shall not require vibration during placement, flow without noticeable segregation, self-consolidate, and be excavatable with hand tools.

B. Sand gradation (U.S. Standard Sieve/Percent Passing)

1. 3/8-inch/100
2. No. 4/95-100
3. No. 16/45-80
4. No. 50/10-30
5. No. 100/2-10
6. No. 200/0-3

C. Cement, water, and chemical admixtures to meet requirements of Section 03 30 00.

D. The 28-day and 90-day compressive strengths, measured in accordance with ASTM D4832, shall be between 30-80 psi and less than 100 psi, respectively.

2.06 CONCRETE FILLED STAIR TREAD

A. Concrete shall be as specified in this section for concrete fills.

B. Reinforcement shall be 2x2–W1.4xW1.4 welded wire, meeting ASTM A1064.

2.07 EPOXY ADHESIVE

A. Epoxy adhesive for installation of post-installed reinforcing bars denoted as “Drill and Epoxy” or “Drill & Epoxy” on Drawings.

B. Evaluation Requirements: ICC-ES evaluation report stating product is compliant with International Building Code and approved for use to resist static, wind and earthquake (Seismic Design Categories A through F) tension and shear loads in cracked and uncracked normal-weight concrete having a compressive strength of 2,500 psi to 8,500 psi. Evaluation reports with a listed renewal date month/year which is prior to the month/year the product is submitted for engineer’s review will be rejected.

C. Epoxy adhesive for anchoring reinforcement to concrete shall be a 2-component solid epoxy-based system supplied in manufacturer's standard side-by-side cartridge and dispensed through manufacturer's standard static-mixing nozzle. Epoxy adhesive shall be:

1. Simpson Strong Tie: SET-3G or ET-HP

a. SET-3G Compliance Report (ESR-4057)

b. ET-HP Compliance Report (ESR-3372)

2. Hilti: HIT-RE 500 V3

a. Compliance Report (ESR-3814)

3. Approved equal based

a. Compliance Report to be submitted

D. Epoxy adhesive shall pass the creep test requirements of ICC-ES AC58.

E. The embedment depth shall be per the manufacturer's requirements and the ultimate strength exceeds the tensile strength of the bar, and the ultimate strength divided by a minimum factor of safety of 3.75 is at least 40 percent of the yield strength of the bar.

2.08 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements. Comply with applicable reference standards listed in Article 1.03.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Comply with applicable reference standards listed in Article 1.03.

3.02 EQUIPMENT PADS

A. New concrete surfaces upon which equipment pads are to be built shall receive a scratched finish in accordance with Section 03 30 20.

B. All laitance shall be removed and the surface shall be saturated with water for a minimum of 6 hours. Excess water shall then be removed and the epoxy bonding compound applied as specified in Section 03 30 20.

C. All equipment pads shall be sized to suit the approved equipment, and reinforcement shall be as shown on the Drawings.

D. The top surface shall be level within 1/8-inch. All exposed faces shall be formed with smooth forms and shall be smooth and free of sands streaks, bug holes, and honeycomb. All exposed surfaces shall have a smooth, even surface with all exterior corners chamfered. Exposed faces of pads shall receive a sack-rubbed finish as specified in Section 03 30 20.

E. All anchor bolts, dowels, sleeves, and other fittings required for the equipment shall be built in.

3.03 GROUTING

A. Grouting is required for structural, mechanical, and electrical items, and shall be in accordance with the manufacturer's recommendations.

B. Concrete surfaces to receive grout shall be cleaned of all contamination and debris. Surface roughening shall be required if laitance or poor concrete is evident.

C. Grout placement shall be rapid and continuous such that grout completely fills the space to be grouted, absent of air pockets.

D. Grout may be placed by gravity or pumped. When practical, grout shall be placed from one side and made to flow to the open side to prevent the formation of air pockets.

3.04 CONCRETE FILLS

A. New unformed concrete surfaces upon which concrete fills are to be placed shall receive a rough broom scratched, rough screed, or rough wood float finish in accordance with Section 03 30 20. However, where concrete fills are to be screeded into place by process equipment, the concrete surface shall receive a scratched finish in accordance with Section 03 30 20.

B. All laitance shall be removed and the surface shall be saturated with water for a minimum of 6 hours. Excess water shall then be removed and the epoxy-bonding compound applied as specified in Section 03 30 20.

C. Concrete fills and/or toppings shall be hammer sounded after placement. Any hollow areas shall be saw cut out and replaced as directed by the Engineer at no additional cost to the Owner.

3.05 EXISTING CONCRETE

A. Where equipment pads are to be constructed, grouting is to be performed, and concrete fills are to be placed against existing concrete, the following surface preparation shall be required.

1. The existing concrete surface shall be cleaned of all contamination and debris, and roughened by steel shot blasting, abrasive sand blasting, or water jetting. Use of scabblers, scarifiers, bush hammers, and pneumatic hammers is not permitted.

2. The existing concrete surface shall be water-saturated for a minimum of 6 hours, after which the excess water shall be removed immediately prior to placement of new concrete or grout.

3. In areas where equipment pads are to be constructed and concrete fills are to be placed, apply epoxy-bonding compound (as specified in Section 03 30 20) to prepared concrete surface prior to concrete placement.

3.06 DUCTBANKS

A. There shall be a minimum of 4 inches of concrete between the outside of a duct and surrounding soil. There shall be not less than 3 inches of concrete between adjacent ducts.

B. All ductbank concrete placements shall be continuous between manholes and handholes, and between manholes, handholes, and structures.

C. Where ducts pass through a foundation wall, the concrete encasement shall extend through the wall and be flush with inside face per the details on the Drawings. Watertight construction joints shall be provided.

3.07 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements. Comply with applicable reference standards listed in Article 1.03.

B. Manufacturer’s Field Services

1. Epoxy Adhesive

a. Except where specified to be performed by personnel certified by an applicable program such as the ACI/CRSI Adhesive Anchor Installer Certification program or equivalent, as approved by the Engineer, the Contractor shall furnish the services of a competent manufacturer's field representative who shall be present at the Work Site prior to beginning installation in order to instruct the Contractor and the Engineer on proper installation and inspection procedures.

b. Installation of anchors horizontally or upwardly inclined to resist sustained tension loads shall be continuously inspected by the Engineer’s special inspector approved for that purpose.

c. Proof loading: performed where required per ACI 355.4.

3.08 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 03 20 00

CONCRETE REINFORCING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide materials, tools, equipment, and labor for the fabrication and installation of reinforcement as shown on Drawings, as specified, and in accordance with this Section and applicable reference standards listed in Article 1.03.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. American Concrete Institute (ACI)

a. ACI 117 Specifications for Tolerances for Concrete Construction and Materials and Commentary

b. ACI SP-66 ACI Detailing Manual

2. ASTM International (ASTM)

a. ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

b. ASTM A767 Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement

c. ASTM A775 Standard Specification for Epoxy-Coated Steel Reinforcing Bars

d. ASTM A1064 Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

3. American Welding Society (AWS)

a. AWS D1.4 Structural Welding Code – Reinforcing Steel

4. Concrete Reinforcing Steel Institute (CRSI)

a. CRSI 10MSP Manual of Standard Practice

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data

1. Certified mill reports, including chemical and physical analyses

2. Dowel bar splicers and dowel inserts

C. Shop Drawings

1. Reinforcement Drawings: Comply with ACI SP-66, and include the following information

a. Sizes, dimensions, and locations for reinforcement and supports

b. Bending diagrams and schedules

c. Splices

d. Cover and clearances

e. Class designation and details of bar supports

f. Pertinent reinforced concrete details with dimensions and elevations

g. Items furnished by other trades or under other sections of the Specification that are to be cast in concrete where interference with reinforcement may occur

h. Reinforcement shall be shown on wall elevations with required sections, on beam elevations with required sections, on plan views of slabs with required sections. Provide plan details where walls intersect.

D. Closeout and maintenance material submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Fabricate reinforcement in accordance with ACI 117.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Deliver reinforcement in bundles with tags indicating size, length, and identification mark.

C. Store materials off the ground to prevent soiling and to facilitate subsequent inspection and handling.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 STEEL REINFORCEMENT

A. General

1. Comply with applicable reference standards listed in Article 1.03.

2. Steel reinforcement includes bars, anchorages, stirrups, dowels, ties, tie-wire, chairs and other steel supports, and spacers as noted on Drawings, specified, and as required for proper completion of Work.

B. Materials

1. Reinforcement bars: formed from new billet steel conforming to ASTM A615, Grade 60 except as otherwise specified.

2. Reinforcement bars: formed from new billet steel conforming to ASTM A615, Grade 60, galvanized per ASTM A767.

3. Plain wire fabric: per ASTM A1064. Flat sheets shall be used, rolls are not permitted.

C. Tie Wire

1. 16-gauge minimum

2. FS QQ-W-461 annealed black, except for architectural concrete

3. ASTM A1064 galvanized steel, for architectural concrete

D. Bar Supports

1. Chairs, bolsters, spacers and other supports to properly position reinforcement shall conform to the bar support recommendations of CRSI 10MSP, and shall be of adequate strength and design to prevent displacement of reinforcement and discoloration of concrete.

2. Supports shall be Class 1 - plastic protected.

3. Supports for bottom reinforcement of slabs on soil shall be chairs with integral plates, or precast concrete blocks not less than 4-inches square with a compressive strength equal to that of the surrounding concrete. Precast blocks may only be used to support reinforcement not more than 3-inches from the bottom of the slab.

E. Fabrication

1. Steel reinforcement shall be fabricated to the sizes, shapes and dimensions shown on the Drawings, details and schedules. All bending shall be in accordance with CRSI 10MSP. All steel shall be bent cold and shall not be bent or straightened in a manner that will injure the metal. Bars with kinks or bends not so detailed shall not be used.

2. Bends for stirrups and ties shall be made around a pin having a diameter not less than 4 times the diameter of the bar. Bends for other bars shall be made around a pin having a diameter not less than 6 times the diameter of the bar, except for bars larger than 1-inch, the pin shall be not less than 8 times the diameter of the bar.

F. Dowel Bar Splicers and Dowel Inserts (DBS/DI)

1. Dowel bar splicers shall be a 2-component threaded rebar splice system. The internally threaded component shall be forged from Grade 60 deformed rebar material free of external machining or welding. It shall contain an integral flange with nailing holes and be threaded with Unified National Coarse (UNC) or UN (unified) threads to a depth equal to the nominal diameter of the threads plus 1/4 inch. The externally threaded splice component shall be fabricated from Grade 60 deformed rebar material and supplied with rolled threads corresponding with the internally threaded component. The root diameter of the threads shall provide a minimum cross sectional area equal to the cross sectional area of the nominal bar size. Manufacturer testing shall indicate ultimate tension failure occurring in the nominal bar diameter, not at the mechanical splice.

2.02 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements. Comply with applicable reference standards listed in Article 1.03.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Comply with applicable reference standards listed in Article 1.03.

B. Reinforcement

1. Tolerances: per ACI 117.

2. Placement

a. Reinforcement shall be accurately positioned both horizontally and vertically, and shall be properly secured and sufficiently rigid to prevent displacement during concrete placement.

b. Reinforcement shall be securely tied at intersections with tie wire or clips in a manner that will keep all metal away from exposed concrete surfaces.

3. Splices

a. Reinforcement splices shall be as shown on the Drawings. Where not shown, splices shall be located away from areas of maximum stress, and shall be approved by the Engineer.

b. Welding shall only be permitted by written approval of the Engineer, and shall be in accordance with AWS D1.4.

4. All reinforcement within an area of a continuous concrete placement shall be installed, supported, and secured before beginning the concrete placement.

5. Reinforcement Adjustment

a. Adjust to within allowable tolerances to avoid interference with other reinforcement, conduits, or embedded items.

b. Reinforcement shall not be moved beyond allowable tolerances without the Engineer's approval.

c. Reinforcement shall not be heated, bent or cut without approval Engineer's approval.

C. Wire Fabric

1. Wire fabric shall be installed in the longest practicable sheet.

2. Adjoining sheets shall be lapped a minimum of 1-1/2 wire spacing's and securely wired together.

3. End laps in adjacent sheets shall be offset.

D. All reinforcement shall be entirely free from flaking rust, loose mill scale, grease, dirt, etc. that might reduce its bond with the concrete.

E. Concrete cover for reinforcement shall conform to the dimensions shown on the Drawings.

F. Notify the Engineer at least 24 hours before placing concrete. All reinforcement within the area of 1 day's concrete placement shall be tied in place and observed by the Engineer or Owner's representative, prior to commencing concrete placement.

3.02 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements. Comply with applicable reference standards listed in Article 1.03.

3.03 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide cast-in-place concrete in accordance with this Section and applicable reference standards listed in Article 1.03.

B. Related Requirements

1. Section 03 16 00 – Concrete Specialties

2. Section 03 30 20 – Concrete Placing, Curing and Finishing

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. American Concrete Institute International (ACI)

a. ACI 117 Specifications for Tolerances for Concrete Construction and Materials and Commentary

b. ACI 301 Specifications for Structural Concrete

2. ASTM International (ASTM)

a. ASTM C31 Standard Practice for Making and Curing Concrete Test Specimens in the Field

b. ASTM C33 Standard Specification for Concrete Aggregates

c. ASTM C40 Standard Test Method for Organic Impurities in Fine Aggregates for Concrete

d. ASTM C88 Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

e. ASTM C94 Standard Specification for Ready-Mixed Concrete

f. ASTM C131 Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

g. ASTM C143 Standard Test Method for Slump of Hydraulic-Cement Concrete

h. ASTM C150 Standard Specification for Portland Cement

i. ASTM C173 Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method

j. ASTM C231 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

k. ASTM C260 Standard Specification for Air-Entraining Admixtures for Concrete

l. ASTM C295 Standard Guide for Petrographic Examination of Aggregates for Concrete

m. ASTM C494 Standard Specification for Chemical Admixtures for Concrete

n. ASTM C535 Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

o. ASTM C586 Standard Test Method for Potential Alkali Reactivity of Carbonate Rocks as Concrete Aggregates (Rock-Cylinder Method)

p. ASTM C618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

q. ASTM C989 Standard Specification for Slag Cement for Use in Concrete and Mortars

r. ASTM C1105 Standard Test Method for Length Change of Concrete Due to Alkali-Carbonate Rock Reaction

s. ASTM C1157 Standard Specification for Hydraulic Cement

t. ASTM C1260 Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)

u. ASTM C1293 Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction

v. ASTM C1567 Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)

w. ASTM C1602 Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete

x. ASTM E329 Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

1. Test Reports

a. Provide reports by testing agencies per ASTM E329.

2. Design Data for Each Concrete Mixture

a. Submit mix designs for each concrete mixture specified in the Concrete Mix Design Schedule

b. Submit minimum 14 days before initial placement of concrete.

c. Proportions for ingredients, 28-day design compressive strength, water to cementitious materials ratio, admixture dosages, slump, and air content.

d. Test data supporting proportions based upon laboratory trial batches or field test records according to ACI 301 Section 4, Concrete Mixtures.

1) Field test data used to determine the standard deviation used for establishing the required average design strength from within the previous 12 months, according to ACI 301.

2) Field test data documenting proposed concrete proportions will produce an average compressive strength equal to or greater than the required average compressive strength from within the previous 12 months.

3) Laboratory trial batch data shall be from within the previous 24 months.

3. Cement: certified mill reports, not older than 90 days.

4. Supplementary cementitious materials: source and test reports for actual material to be used in the Work, not older than 90 days.

   a. Fly ash

   b. Ground granulated blast-furnace slag

5. Aggregate

   a. Data not older than 90 days, except test data for soundness, abrasion, and alkali reactivity - not older than 1 year.

   b. Fine and coarse aggregate data, except as specified

      1) Sources

      2) Specific gravity

      3) Sieve analyses according to ASTM C33 (including fineness modulus of fine aggregate)

      4) Organic impurities for fine aggregate according to ASTM C40

      5) Potential alkali reactivity (not required if a cement containing less than 0.60 percent alkalis is used, according to ASTM C33) according to ASTM C1260, ASTM C1293, or ASTM C1567. Aggregate sources on the list of "MassDOT Cement Concrete Non-Alkali Silica Reactive Aggregate Sources" may submit their approval in lieu of alkali reactivity testing.

      6) Soundness according to ASTM C88

      7) Abrasion for coarse aggregate according to ASTM C131 and ASTM C535

6. Admixture product data and instructions

7. Sample batch ticket from concrete batch plant

B. Closeout and maintenance material submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Storage and Protection for Material for On-Site Batching

1. Carefully store cement immediately upon receipt in a weatherproof structure, as airtight as practical to prevent moisture absorption, stacked closely to reduce air circulation, but not against exterior walls. Allow easy access for inspection and shipment identification.

2. Transfer bulk cement to elevated airtight weatherproof bins. Test quality of cement that has been stored for suitability if quality is questionable and do not use without approval.

3. Store aggregates to prevent contamination by foreign materials and in separate piles by size. Build coarse aggregate stockpiles in horizontal layers not exceeding 4-feet in depth to avoid segregation.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 SOURCE

A. Provide concrete supplied from a single commercial ready-mix plant, mixed and delivered according to ASTM C94, except if plant does not exist within a reasonable distance from Site, furnish material for on-Site batching and store as specified.

2.02 CONCRETE MATERIALS

A. Comply with applicable reference standards listed in Article 1.03.

B. Concrete Mixture Design

1. Comply with ACI 301, Section 4, Concrete Mixtures.

2. 28-day design compressive strength: 4,500 pounds per square inch, except as otherwise specified.

3. Water to cementitious materials ratio: not to exceed 0.42 except as otherwise specified.

4. Provide designs of required strength, water to cementitious materials ratio, slump, and workability for placing conditions and specified finishes without segregation.

5. Slump: ASTM C143.

   a. Specified Slump Range: 3 inches to 5 inches

   b. Specified Slump Range for mixes with mid-range water reducer: 2 inches to 4 inches, before admixture is added; maximum 6 inches, after admixture is added.

   c. Specified Slump range for mixes with high-range water reducer: 2 inches to 4 inches, before admixture is added; maximum 8 inches, after admixture is added.

C. Cement: ASTM C150, Type II or ASTM C595 IP(MS), IS (less than 70)(MS). Do not use ASTM C595 cements that contain ASTM C1157 cement. If equivalent alkali content is greater than 0.60 percent, submit aggregate reactivity testing as specified.

D. Supplementary Cementitious Materials

1. Fly ash (optional): ASTM C618, Class F.

   a. Maximum loss of ignition: 3.0 percent.

   b. Minimum 15 percent and maximum 25 percent of weight of cement plus fly ash

   c. Maximum available alkalis: 5 percent.

2. Ground-granulated blast furnace (GGBF) slag (optional): ASTM C989.

   a. Activity classification: Grade 100 or 120.

   b. Minimum 25 percent and maximum 50 percent of weight of cementitious material

3. Fly ash plus GGBF slag: maximum 50 percent of total cementitious materials.

   a. Fly ash portion: maximum 25 percent of total cementitious materials.

   b. Minimum portland cement: 337 pounds per cubic yard of concrete.

E. Aggregate: ASTM C33, as amended.

1. Evidence of a satisfactory service record in lieu of testing for alkali reactivity is not permitted.

2. Do not use crushed hydraulic cement concrete for aggregate.

3. Any aggregate sources provided after July 1, 2024 shall be tested for the presence of pyrrhotite as required by MassDOT.

4. Aggregate reactivity testing: according to ASTM C1260. Do not use aggregate having a 14-day expansion greater than 0.10 percent (considered potentially reactive), except if tested according to ASTM C1567, the 14-day expansion is not greater than 0.10 percent, or if tested according to ASTM C1293, the 2-year expansion is not greater than 0.04 percent, or if cement containing less than 0.60 percent alkalis is used according to ASTM C33. In lieu of the above, Alkali-Silica Reactivity (ASR) mitigation may be by substitution of a minimum 25 percent fly ash or 50 percent GGBF slag for cement by weight. Aggregate sources on the list of "MassDOT Cement Concrete Non-Alkali Silica Reactive Aggregate Sources" may submit their approval in lieu of alkali reactivity testing.

5. Compliance with Massachusetts General Law Chapter 6 Section 79: Provide Aggregate testing to identify the presence of pyrite and pyrrhotite required under subsection (b) which shall include, but shall not be limited to, a total sulfur test to measure total sulfur content in a representative sample. Aggregate testing shall be performed by an accredited laboratory in accordance with applicable standards established by American Society of Testing and Materials International or alternate standards to be determined by the department in consultation with the state geologist.

6. Fine aggregates: sand or screenings of gravel or crushed stone, well graded from fine to coarse; clean and free from soft particles, clay, loam and organic matter, with the volume removed by sedimentation not more than 3 percent.

    a. Organic impurities testing: according to ASTM C40. Color of the supernatant liquid above the test sample: not darker than organic plate No. 3.

    b. Grading

U.S. Standard Sieve	Percent Passing
Size 3/8 inch	100
No. 4	95 - 100
No. 8	80 - 100
No. 16	50 - 85
No. 30	25 - 60
No. 50	5 -30
No. 100	0-10

c. Maximum 45 percent retained between any 2 consecutive sieves listed above. Fineness modulus: minimum 2.3 and maximum 3.1.

7. Coarse aggregates: crushed stone or washed gravel of clean, hard, durable, uncoated particles, free from dust, dirt, or other deleterious substances, and free from thin, flat, or elongated particles.

a. Nominal maximum aggregate size for slabs poured on ground and minimum 15 inches thick: 1-1/2 inches where clear spacing between reinforcing bars is greater than 2 inches:

b. Nominal maximum aggregate size at all other locations: 3/4-inch 1-inch.

c. Nominal maximum aggregate sizes per grading in Table 2 of ASTM C33: No. 467 (1-1/2 inches), No. 57 (1-inch), No. 67 (3/4-inch), No. 7 (1/2-inch), and No. 8 (3/8-inch).

F. Admixtures

1. Air-entraining admixture: ASTM C260 and chloride free.

a. Provide air entrainment, except as specified below, to produce the following total entrained air content determined according to ASTM C173 or ASTM C231.

Nominal Maximum Size Coarse Aggregate (inches)	Air Content By Volume (percent plus or minus 1.5)
3/8	7.5
1/2	7.0
3/4	6.0
1	6.0
1-1/2	5.5

b. Maximum air content for interior concrete slabs to be hard-troweled: 3.0 percent.

2. Mid-range water reducing agents: according to ASTM C494, Type A, with consideration of air entraining effect of water reducing agent.

3. Use water reducing-retarding agents when ambient temperature is above 70 degrees. Replace water reducing agent in whole or part with water reducing-retarding agent meeting ASTM C494, Type D. Use amounts to produce concrete with set time equal to that at 70 degrees F without the retarder.

4. Set accelerator: non-chloride type conforming to ASTM C494, Type C or E where allowed under Section 03 30 20.

5. High-range water reducing agent: ASTM C494, Type F or G (added in plant or field).

G. Water: per ASTM C1602.

1. Use fresh water, free from oil, acid, salt, alkali, sewage, organic matter, and other deleterious substances.

2. The amount of water carried on the aggregate and the effect of admixtures is included in the water content. Provide that water carried on the aggregate is determined periodically by test and the amount of free water on the aggregate subtracted from water added to the mixture.

3. Residual, wash, or other water in drums: completely discharged prior to concrete batching (drums backed out).

4. Use maximum amount of water required to produce a plastic mixture of the strength and water-to-cementitious materials ratio specified, and to produce a mixture of the required density, uniformity and workability. Consistency of mixture: as required for the specific placing conditions and methods.

5. Do not make slump adjustment at wash down, slump rack, or by any other means prior to arrival at point of delivery at the Site.

2.03 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements. Comply with applicable reference standards listed in Article 1.03.

PART 3 – EXECUTION

3.01 GENERAL

A. Comply with applicable reference standards listed in Article 1.03.

B. Water added after arrival at Site: accurately metered and recorded on the batch ticket.

3.02 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements. Comply with applicable reference standards listed in Article 1.03.

B. Provide minimum 24 hours' notice to laboratory and field observers in advance of placing concrete to allow for scheduling observation and testing.

C. Assist testing laboratory and Engineer in obtaining and handling Samples at the Site and other sources of material.

D. Provide space and electrical power at the Site for facilities to be provided by Contractor's testing agency for proper initial curing and storage of concrete test cylinders to be lab-cured as required by ASTM C31 for 48 hours after casting. For cylinders to be field-cured: per Section 03 30 20.

E. Contractor's testing agency to store cylinders to be lab-cured at 60 degrees F to 80 degrees F in an environment preventing moisture loss from the specimens such as storage in wooden boxes, and placement in damp sand pits. Shield specimens from direct sunlight and radiant heating devices. Control storage temperature by use of heating and cooling devices as necessary and record temperature with a maximum-minimum thermometer.

3.03 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

3.04 ATTACHMENTS

A. Concrete Mix Design Schedule

END OF SECTION

ATTACHMENT A - CONCRETE MIX DESIGN SCHEDULE

The following table provides a list of concrete mixtures required for the Project. Obtain a concrete mix design for each of the concrete mixtures listed from Supplier and submit per Article 1.05.

Concrete Mixture	Min Comp Strength (psi)	Max W/C Ratio	Air Entrained	Description of Use
Main Mix Design with air	4,500 at 28 days	0.42	Yes	Use for all concrete, unless noted otherwise, exterior slabs-on-grade and equipment pads
Early Strength	4,500 at 7 days	TBD	Yes	High-early strength concrete to expedite concrete tank strength-gain to reduce construction schedule for tightness testing and backfilling. This mix design is not a Project requirement but may be used by the Contractor at its discretion.
Concrete Fills	4,000 at 28 days	0.45	Yes	Section 03 16 00
Duct Banks & Mud Mat	3,000 at 28 days	0.55	Yes	Section 03 16 00
Controlled Low- Strength Material	See Specification	N/A	See Specification	Section 31 00 00

END OF ATTACHMENT A

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SECTION 03 30 20

CONCRETE PLACING, CURING AND FINISHING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide placing, curing and finishing of cast-in-place concrete accordance with this Section and applicable reference standards listed in Article 1.03.

2. Concrete sampling and field testing by an independent technician certified in accordance with the requirements of ACI Concrete Field Testing Technician – Grade 1 certification program, or the requirements of ASTM C1077. Paid for by Contractor.

3. Laboratory testing of concrete cylinders by an independent, accredited and certified testing laboratory. Paid for by Contractor.

B. Related Requirements

1. Section 03 11 00 – Concrete Forming

2. Section 03 16 00 – Concrete Specialties

3. Section 03 30 00 – Cast-In-Place Concrete

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. American Concrete Institute International (ACI)

a. ACI 117 Specifications for Tolerances for Concrete Construction and Materials and Commentary

b. ACI 301 Specifications for Structural Concrete

c. ACI 306.1 Standard Specification for Cold Weather Concreting

d. ACI 308.1 Standard Specification for Curing Concrete

e. ACI 350.1 Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures

f. ACI 306R Cold Weather Concreting

2. ASTM International (ASTM)

a. ASTM C31 Standard Practice for Making and Curing Concrete Test Specimens in the Field

b. ASTM C39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

c. ASTM C42 Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

d. ASTM C143 Standard Test Method for Slump of Hydraulic-Cement Concrete

e. ASTM C144 Standard Specification for Aggregate for Masonry Mortar

f. ASTM C171 Standard Specification for Sheet Materials for Curing Concrete

g. ASTM C172 Standard Practice for Sampling Freshly Mixed Concrete

h. ASTM C173 Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method

i. ASTM C231 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

j. ASTM C309 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

k. ASTM C404 Standard Specification for Aggregates for Masonry Grout

l. ASTM C578 Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation

m. ASTM C881 Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete

n. ASTM C1064 Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete

o. ASTM C1077 Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation.

p. ASTM C1315 Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete

q. ASTM D2486 Standard Test Methods for Scrub Resistance of Wall Paints

r. ASTM D4541 Standard Test Methods for Pull-Off Strength of Coatings Using Portable Adhesion Testers

s. ASTM D4810 Standard Specification for Flexible Cellular Materials made from Polyolefin Plastics

t. ASTM E1155 Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers

u. ASTM E1745 Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs

B. Definitions

1. Construction joint refers to a monolithic construction joint in which the surface between successive placements is prepared to enhance bond and shear transfer and reinforcement is continuous.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data and Manufacturer's Instructions

1. Delivery Tickets

a. Provide duplicate delivery tickets at time of delivery for each truckload of concrete delivered

b. Serial number of ticket

c. Date and Project location

d. Name and location of ready mixed concrete plant

e. Truck number, time loaded, cubic yardage delivered

f. Dispatcher's name

g. Mixture design, cement type, and admixtures with brand names

h. Types and quantities of cement, fly ash and/or slag (if included in approved mix design) and admixtures. Quantities of water and fine and coarse aggregate including moisture content, and nominal maximum aggregate size

i. Water added subsequent to plant batching, if any. (Only applicable if total water per mixture design is not added at plant. Addition of water such that the water content of the approved mixture design is exceeded will be strictly prohibited.)

j. Concrete temperature upon delivery

k. Unloading time and location

2. Curing Paper

3. Epoxy Bonding Compound

4. Evaporation Retardant

5. Cure and Seal Compound

6. Curing Compound

7. Preformed Joint Filler

C. Source and Field Quality Control Submittals

1. Methods to be used to protect concrete placed during cold weather. The Engineer's review does not constitute approval. Protect concrete placed during cold weather.

2. Methods to be used to protect concrete placed during hot weather. The Engineer's review does not constitute approval. Protect concrete placed during hot weather.

D. Closeout and maintenance material submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Protection

1. Provisions shall be made for maintaining new concrete in a continuously moist condition for at least seven days after placement

2. Fresh concrete shall be protected from freezing, premature drying, flowing water, and mechanical injury

3. Concrete shall not be placed while rain, sleet, or snow is falling unless acceptable protection is provided. Precipitation shall not be allowed to enter into the concrete mix or damage concrete surfaces

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 GENERAL

A. Comply with applicable reference standards listed in Article 1.03.

2.02 PREFORMED JOINT FILLER

A. Preformed joint filler: ASTM D4819, closed cell polyethylene foam isolation joint material, 1/2” thick unless noted otherwise on drawings. Joint filler shall be Deck-O-Foam by W.R. Meadows, or equal.

2.03 CURE AND SEAL COMPOUND

A. Water Based Cure and Seal Compound: Conform to ASTM C309, Type 1, and ASTM C1315, Type 1 with minimum 25 percent solids, non-yellowing, non-staining, and UV light resistant.

1. MasterKure CC 1315WB, by Master Builders; Vocomp-25, by W.R. Meadows; Dress & Seal WB 25, by L&M Construction Chemicals, Inc.; or approved equal shall be provided.

2. Approved Use: Water based products are preferred and approved for application to surfaces with a surface temperature above 50F for interior or exterior surfaces.

3. Limitations: Not permitted for Cold weather application to surfaces temperatures less than 50F. Not permitted for surfaces to receive additional concrete fills, chemical hardeners, sealers, waterproofing, and architectural finishes such as concrete stain, paints and coatings, tile, carpet, and floor covering adhesives. Not permitted for surfaces to receive a sack-rubbed finish.

B. Solvent based cure and seal compound: ASTM C309, Type 1, and ASTM C1315, Type 1 with minimum 25 percent solids, non-yellowing and non-staining, and UV light resistant.

1. MasterKure CC 250 SB, by Master Builders; CS-309-25, by W.R. Meadows;Dress & Seal 30, by L&M Construction Chemicals, Inc.;

2. Approved use: exterior surfaces with surface temperature above 40 degrees F.

3. Limitations: not permitted for surfaces with a surface temperature less than 40 degrees F. Not permitted for surfaces to receive additional concrete fills, chemical hardeners, sealers, waterproofing, and architectural finishes such as concrete stain, paints and coatings, tile, carpet, and floor covering adhesives. Not permitted for surfaces to receive a sack-rubbed finish.

2.04 CURING COMPOUND

A. Curing compound: ASTM C309, Type 1, Class A.

1. 1300 Clear, by W.R. Meadows; L&M Cure, by L&M Construction Chemicals, Inc., or equal.

2. Approved use: building wall footings, building foundation walls, exterior face of basement walls, and concrete sidewalks.

3. Limitations: not permitted for building interior surfaces; exterior concrete equipment pads; concrete tank structures.

2.05 DISSIPATING CURING COMPOUND

A. Curing compound: ASTM C309, Type 1, Class B resin-based curing compound that will normally oxidize and begin to wear off in 30 to 60 days.

1. Acceptable level of quality: equivalent to 1100 Clear, by W.R. Meadows; and L&M Cure W, by L&M Construction Chemicals, Inc.

2. Approved use: concrete sidewalks and building floor slabs to receive carpet, tile, and floor covering adhesives.

2.06 CURING PAPER

A. Curing paper: consisting of 2 layers of kraft paper cemented together and reinforced with fiber and conform to ASTM C171, for regular or white waterproof paper. Use regular if ambient temperatures are below 60 degrees F.

2.07 EPOXY BONDING COMPOUND

A. Epoxy bonding compound: ASTM C881, contain 100 percent solids, and be moisture tolerant. Acceptable level of quality: equivalent to Sikadur 32 Hi-Mod or Sikadur 32 Hi-Mod LPL, by Sika Corporation; Sure-Bond (J-58, or J-58 LPL), by Dayton Superior.

B. Where larger placements require open times greater than 2 hours, provide acceptable level of quality: equivalent to Sika Armatec 110 EpoCem for larger placements.

2.08 EVAPORATION RETARDANT

A. Evaporation retardant: water-based polymer liquid placed on fresh concrete to control the rate of evaporation and extend workability. Provide E-CON by L&M Construction Chemicals, Inc.; SikaFilm by Sika Corporation; MasterKure ER 50 by Master Builders; or equal.

2.09 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Comply with applicable reference standards listed in Article 1.03.

3.02 CONCRETE PLACEMENT AND JOINTING

A. Tolerances to conform to requirements of ACI 117.

B. Cold Weather Requirements

1. Cold weather concrete provisions shall be followed during cold weather: when air temperature is expected to fall below 40 degrees F during the protection period. The protection period is defined as the time recommended to prevent concrete from being adversely affected by exposure to cold weather during construction. Protection period shall be 6 days for normal-set concrete, and 4 days for accelerated-set concrete.

2. When freezing temperatures may occur during periods not defined as cold weather, concrete surfaces shall be protected against freezing for at least the first 24 hours after placing.

3. Concrete shall not be placed on frozen subgrade. Insulate or heat subgrade to ensure temperature above 32 degrees F when concrete is placed.

4. All embedment's having a cross sectional area of 1.0 square inch or greater, and including #9 reinforcing bars, shall be at a temperature not less than 10 degrees F at time of concrete placement.

5. Thermal protection must be provided immediately after concrete placement. Procedures for covering, insulating, housing, and/or heating concrete shall be prearranged. Except when supplemental heat is provided, the R-value of the insulation shall be per the recommendations of chapter 9 of ACI 306R.

6. Accelerating admixtures to be approved at Engineer's discretion, however those containing calcium chloride are not permitted.

7. When combustion heaters are used, flue gases shall be vented to the exterior of enclosures.

8. Concrete shall be placed and maintained at the following minimum concrete placement temperatures (measured at concrete surface).

   a. Sections of less than 12-inch minimum dimension: 55 degrees F.

   b. Sections of 12 to 36 inches minimum dimension: 50 degrees F.

9. The concrete placement temperature shall not be higher than the minimum concrete placement temperature by more than 20 degrees F.

10. The minimum concrete temperature as mixed shall be: 5 degrees F higher than the minimum concrete placement temperature when the air temperature is above 30 degrees F; 10 degrees F higher when the air temperature is between 0- and 30-degrees F; and 15 degrees F higher when the air temperature is less than 0 degrees F.

11. Monitor temperature at the surface of the concrete, including at corners and edges, which are more vulnerable to freezing. The concrete surface temperature and the corresponding outside air temperature to be recorded a minimum of twice per each 24-hour period.

12. Concrete shall be maintained at the minimum specified temperatures for a protection period of 6 days. When an approved accelerating admixture is used the protection period may be reduced to 4 days.

13. Slabs, regardless of air content, may not be exposed to freezing temperatures when exposed to rain, snow or other water sources, prior to reaching a compressive strength of 3,500 psi. For hard-troweled slabs (which have a maximum air content of 3.0 percent) provide as specified.

14. Concrete shall be cooled gradually at the end of the protection period. The maximum allowable temperature drop at the concrete surface during the first 24 hours after the protection period shall be: 50 degrees F for concrete sections of less than 12-inch minimum dimension; and 40 degrees F for concrete sections of 12 to 36 inch minimum dimension.

C. Hot Weather Requirements

1. The temperature of the concrete when placed shall not exceed 90 degrees F. When the air temperature is 90 degrees F and above, procedures to cool mixture ingredients may be warranted. These include providing shaded storage for aggregate, frequent sprinkling or fog spraying of coarse aggregate, and using chilled batch water and/or ice. Forms and reinforcement shall be sprinkled with cold water just prior to concrete placement. When possible, placement of slabs should be scheduled after walls and roof structure are in place in order to minimize problems associated with direct sunlight and/or drying winds. Newly placed concrete shall be protected from the direct sunlight.

2. Records shall be maintained of time and location of concrete placement, air temperature, weather conditions (i.e. calm, windy, clear, and/or cloudy), relative humidity, and concrete temperature as delivered and after placement.

3. When the air temperature is 90 degrees F and above: the time between the addition of water to cement or cement to aggregate (whichever occurs first) and the time of concrete placement shall not exceed 60 minutes, except upon approval of the Engineer when all tests for air content, slump and temperature are acceptable.

D. Placing

1. Concrete shall be handled from the truck to the place of final deposit as rapidly as practicable by methods preventing segregation and/or loss of ingredients.

2. The time between the addition of water to cement, or cement to aggregates (whichever occurs first), and the placement of concrete shall not exceed 90 minutes. When air temperature is 90 degrees F and above, this time shall be reduced to 60 minutes. These times may be exceeded only upon approval of the Engineer, and only if all tests for air content, slump, and temperature are also acceptable.

3. Water shall be removed from all forms and excavations and the Work shall be kept dry during placement. No water shall be thrown on, allowed to flow over, or rise upon the concrete until it is thoroughly set.

4. Prior to placement of slabs on soil, the subgrade shall be moist with no free water and no muddy or soft spots.

5. The concrete shall be directly deposited as close as possible to its final location and shall be deposited in such manner so as to maintain a homogeneous, plastic, approximately horizontal surface.

6. Where concrete may contact soil while being placed, free fall shall be limited to a maximum of 3 feet. Concrete that has been contaminated by soil and/or other foreign matter shall be rejected. The accumulation of concrete on the forms and/or on reinforcement above the level of placement shall be avoided. The splashing of concrete upon formwork that is set for a subsequent concrete placement shall be prevented due to the resulting marks on the finished concrete.

7. Re-tempering of concrete and concrete placement against partially hardened concrete shall not be permitted. A concrete placement, once started, shall be carried out as a continuous operation until the placement of the entire section between construction joints is complete.

E. Runways: Runways shall be provided for wheeled concrete handling equipment which shall not be wheeled over reinforcement. Runways shall not be supported upon reinforcement that is part of the Work.

F. Chuting

1. Minimum slope shall be 3 horizontal to 1 vertical and maximum slope shall be 2 horizontal to 1 vertical. Between these limits, the slope shall be that which will prevent segregation and ensure continuous flow.

2. A baffle shall be provided at the end of the chute to prevent segregation. If the end of the chute is more than 3 feet above the surface of deposit, a spout shall be used. The spout shall be kept full of concrete with the end kept as near as practical to the surface of deposit.

3. The chute shall be steel or steel lined, and sections shall have the same slope throughout. Aluminum chutes are not permitted.

4. The chute shall be thoroughly flushed with water before and after each use, the water discharged outside the forms.

G. Pumping: inside diameter of pipes and hoses used to convey the concrete shall be a minimum of three times the maximum size aggregate of the mixture. In order to minimize altering the concrete properties, long vertical sections at the end of the pump line shall be avoided. A horizontal hose run, a hose loop, or a slide gate at the end of the hose may be used to reduce loss of entrained air.

H. Compaction

1. Provide at least one standby vibrator, and at least one for each three in use.

2. Concrete may be deposited in one or multiple layers. Each layer shall be compacted by mechanical internal vibrating equipment supplemented by hand spading, rodding, and tamping as required. The depth of each layer shall not exceed the smaller of 36 inches and the depth that can be properly vibrated with the equipment used. When deposited in multiple layers, the vibrator shall penetrate the previous layer approximately 6 inches. Ensure initial setting of the previous layer does not occur prior to placement of subsequent layer.

3. Vibrators shall be relocated frequently, and over-vibration resulting in segregation shall be prevented. Vibrators shall not be used to move concrete within the forms. Concrete shall be thoroughly consolidated around reinforcement, embedments, and into the corners of the forms.

4. Ensure that vibrator is kept several inches clear of waterstops.

5. Where internal vibration is impractical, the use of form vibrators will be considered, and will be allowed only with the Engineer's written approval. When allowed, the vibrator shall be placed so that motion is horizontal

I. Construction Joints

1. Construction joints shall be located where shown on the Drawings, or, if not shown, locations shall be approved by the Engineer. Where required to be watertight, waterstops as specified in Section 03 11 00 shall be used.

2. Horizontal construction joints: laitance shall be removed immediately after initial set and the surface shall roughened in an acceptable manner that exposes the aggregate uniformly and doesn't leave laitance or loose aggregate. After the concrete has set to a degree that precludes laitance removal by shovels or scrapers, remove it and create a roughened surface, by water jetting or other effective method. The use of pneumatic hammers is not permitted.

3. Vertical construction joints: the surface shall be thoroughly cleaned of laitance by water jetting, or by wire brushing followed by air blasting.

4. Before concrete is placed against set concrete, the surface shall be thoroughly wetted with standing water removed. Horizontal construction joints shall be in a saturated surface dry condition: saturated for a minimum of 6 hours, with standing water removed.

5. Where noted on Drawings, and approved by Engineer where an unplanned interruption within a concrete placement has occurred, use epoxy-bonding compound in accordance with manufacturer's instructions.

6. Reinforcement shall be continuous at construction joints unless otherwise shown on the Drawings. Waterstops shall be provided where called for where specified. All necessary precautions to ensure that the waterstop is properly located and aligned and remains so during concrete placement shall be taken. In the event that the waterstop is improperly located, allowing a tolerance of plus or minus 1/2-inch, Engineer may order the waterstop extended, or replaced, or such other action as deemed necessary, and at no additional cost to the Owner.

J. Concrete Fills

1. New unformed concrete surfaces upon which concrete is placed shall receive a rough (broom, scratched, rough screed, or rough wood float) finish.

K. Existing Concrete

1. Where concrete is placed against existing concrete, the following surface preparation shall be required.

2. The existing concrete surface shall be cleaned of all contamination and debris, and roughened by steel shot blasting, abrasive (sand) blasting, or water jetting (hydrodemolition). Use of scabblers, scarifiers, bush hammers, or pneumatic hammers is not permitted.

3. The existing concrete surface shall be water-saturated for a minimum of six hours, after which the excess water shall be removed immediately prior to placement of new concrete.

4. Apply epoxy-bonding compound to prepared concrete surface prior to concrete placement.

3.03 CURING AND PROTECTION

A. Temperature

1. When the ambient temperature falls below 40 degrees F or rises above 95 degrees F, a record shall be kept of concrete temperatures and of protection given to concrete during placement and curing.

2. The temperature of in-place concrete shall be the surface temperature of the concrete. The surface temperature may be determined by placing temperature sensors in contact with concrete surfaces or between concrete surfaces and covers used for curing, such as insulation blankets or plastic sheeting.

B. Curing

1. Provide curing per ACI 308.1 except as modified.

2. During cold weather, as previously defined, the application of water shall not be required. Curing shall be accomplished by the use of curing paper, curing compounds, cure and seal compounds, or other approved methods. Thermal blankets are not an approved curing method and shall be used in conjunction with curing provisions previously stated.

3. Provisions shall be made for maintaining new concrete in a continuously moist condition for a minimum of 7 days. Curing shall commence as soon as possible after final finishing when it will not mar, erode, or stain the concrete surface.

4. Curing shall be accomplished by the use of curing paper, curing compounds (except as noted below), wet methods (ponding, fog spray, damp sand or burlap, sprinkling, soaker hoses) or other methods.

5. Water used for curing shall be no more than 20 degrees F cooler than the concrete surface temperature.

6. Concrete slabs to receive a coating or bonded finish, including chemical hardeners, that aren't wet cured, shall be covered with curing paper as specified, laid with side joints lapped 4 inches and end joints lapped 6 inches. Paper shall be applied no earlier than 24 hours and no later than 30 hours after finishing the slab and shall be left in place at least seven days. (Wet methods shall be used for the first 24-30 hours.) The slab surface shall be maintained in a wet condition beneath the paper at all times. Joints shall be taped and paper shall be weighted to prevent displacement. Tears during the first 7 days after a slab is completed shall be immediately repaired.

7. Curing paper shall also be used to protect newly poured concrete floors from damage. Where heavy tools and/or equipment may be used, provide additional protection as required. Only light traffic will be permitted until 7 days after concrete placement. Protect slabs from damage for the Project duration. Repair damage at no additional cost to the Owner.

8. The use of a curing compound or cure and seal compound on surfaces to receive applied toppings, chemical hardeners, water repellents, coatings, or a rubbed or bonded finish will not be allowed. Where used, curing compound shall be applied immediately following the disappearance of the surface water sheen after the final finishing pass for slabs, and immediately upon removal of forms for formed concrete. Apply two coats per manufacturer's installation instructions. Apply each coat uniformly with no gaps in coverage. If applied by spray, provide additional spray tank and spray nozzles as required to provide uninterrupted application of product. Cure and seal compounds have high solid content and shall be applied by trays and rollers, if application by spray tanks is not completed in a timely manner and to the satisfaction of the engineer.

9. Soaker hoses shall be used at tops of walls and columns before forms are removed. Wood forms shall be kept continuously wet in hot weather.

3.04 DEFECTIVE CONCRETE

A. The Engineer may direct the Contractor to remove and replace, at no additional cost to the Owner, concrete Work that is not formed as shown and/or specified, or that contains a defective surface.

B. Upon the Engineer's approval, minor imperfections may be patched as specified.

3.05 REPAIR OF SURFACE DEFECTS AND PATCHING

A. After form removal, all form ties shall be cut off, all fins and irregularities removed, and all defective areas, holes, honeycombs, cavities and irregularities shall be repaired where surface finish defects exceed the finish tolerances of Section 3.05

B. Exposed patchwork shall match adjacent finish and shall include a sack rubbed finish to blend repair into adjacent surfaces and cured and protected as specified for concrete.

C. Filling Form Tie Holes: Tie holes shall be filled solid with non-shrink grout, specified in Section 03 16 00, in the same manner as specified under patching above.

3.06 FINISH OF FORMED SURFACES

A. General

1. Concrete surfaces "exposed to view" shall be defined as those exposed to view upon completion of the Work, whether or not a painted finish is specified. Surfaces which will be covered by fill, such as exterior faces of walls, shall not be considered exposed to view.

2. Surface tolerance classes indicated are specified in ACI 117, and include abrupt surface irregularities that are measured within 1-inch of the irregularity, and gradual surface irregularities measured as the maximum gap between the concrete and the near surface of a 5-foot straight-edge, measured between contact points.

B. Surface Finish – 1.0 (SF-1.0)

1. SF-1.0 shall be provided for formed surfaces not exposed to view for concrete not containing liquids and/or gases, and not below design groundwater elevation.

2. Patch voids larger than 1 1/2-inch wide or 1/2-inch deep.

3. Remove projections larger than 1-inch.

4. Tie holes need not be patched.

5. Surface tolerance Class D, with formed surface irregularities not more than 1-inch.

C. Surface Finish – 2.0 (SF-2.0)

1. SF-2.0 shall be provided for formed surfaces not exposed to view for concrete not containing liquids, and/or gases, and below design groundwater elevation.

2. Patch voids larger than 3/4-inch wide or 1/2-inch deep.

3. Remove projections larger than 1/4-inch

4. Patch tie holes

5. Surface tolerance Class B, with formed surface irregularities not more than 1/4-inch.

D. Surface Finish – 3.0 (SF3.0)

1. SF-3.0 shall be provided for formed surfaces exposed to view, for exterior face of walls to receive waterproofing per Specification 07 10 00, and for concrete not containing liquids, and/or gases.

2. Patch voids larger than 3/4-inch wide or 1/2-inch deep. For surfaces to receive waterproofing, patch all voids per the waterproofing manufacturer’s written installation instructions.

3. Remove projections larger than 1/8-inch. For surfaces to receive waterproofing, remove all projections per the waterproofing manufacturer’s written installation instructions.

4. Patch tie holes

5. Surface tolerance Class A, with formed surface irregularities not more than 1/8-inch.

E. Environmental Surface Finish-1.0 (ESF-1.0)

1. ESF-1.0 shall be provided for exterior and interior formed surfaces of concrete tanks containing liquids or gases and concrete to receive grout-cleaned rubbed finish.

2. Patch voids larger than 1/2- inch wide or 1/4-inch. All interior formed surfaces to receive grout-cleaned rubbed finish, unless noted otherwise on drawings.

3. Remove projections larger than 1/8-inch.

4. Fill tie holes.

5. Surface tolerance Class A, with formed surface irregularities not more than 1/8-inch.

F. Grout-cleaned rubbed finish (Sack-Rubbed)

1. All interior and exterior concrete surfaces that are exposed to view shall receive a grout-cleaned rubbed finish and shall have a smooth and even surface, free of bug holes, when completed, unless specifically noted otherwise on drawings.

2. Wet the surface, and apply a thin coat of medium consistency neat cement slurry to the concrete surface by means of bristle brushes to provide a bonding coat. Before the slurry has dried or changed color, grout comprising one part cement to 1 1/2 parts sand meeting ASTM C144 or ASTM C404, with sufficient water to produce the consistency of thick paint, shall be applied and scrubbed into voids, with excess removed. The cement shall be that used in the concrete mix adjusted with white cement as necessary to match color of exposed concrete. Grout shall be applied with slightly damp pads of coarse burlap approximately 6 inches square used as a float, and shall be well scrubbed into the surface to provide a dense mortar.

3. The mortar shall be allowed to partially harden for 1 to 2 hours depending upon weather conditions. Work in direct hot sunlight shall be avoided. In hot dry conditions the concrete shall be kept damp during this period with a fine fog spray. Grout shall not be allowed to remain on the surface too long as it will become very difficult to remove. Grout shall not be left on the concrete overnight.

4. After the grout has hardened sufficiently, all that can be removed with a trowel shall be.

5. The surface shall then be allowed to dry thoroughly, and be rubbed vigorously with clean, dry burlap to completely remove any dried grout. There should be no visible film of grout remaining after rubbing.

6. The entire rubbing operation shall be completed in a single working day. Sufficient time shall be allowed for this.

7. On the following day, the concrete shall again be wiped clean with dry burlap to remove dust. The use of burlap containing old hardened mortar may be used since it will act as a mild abrasive. After this treatment, no build-up film should remain on the surface, but if it does, a fine abrasive stone shall be used to remove it without breaking through the surface film of the parent concrete. Do not work up a lather.

8. After application of the surface grout, the surface shall be thoroughly washed down with stiff brushes and the concrete maintained in a continuously damp condition for at least three days above 50 degrees F by the periodic application of a fine fog spray, the use of damp fabric covered with polyethylene or other methods.

9. Finish shall conceal all form seams. Griding of seams to produce a flush appearance may be required prior to application of slurry.

3.07 FINISHING OF RELATED UNFORMED SURFACES

A. Tops of exposed walls and similar unformed surfaces shall be struck off smooth and hand steel troweled to produce a smooth hard level surface. Line and elevation shall be pre-established by means of preset wood screeds, which shall be removed during the troweling operation.

B. After troweling is completed and after the curing period, the surface shall be dry honed to a smooth non-directional surface texture satisfactory to the Engineer.

3.08 FINISH OF SLABS

A. General

1. The evaporation retardant specified may be used in accordance with manufacturer recommendations to control plastic shrinkage cracking and as an aid in slab finishing operations. Conditions that may warrant its use include: high temperature, low humidity, high winds, and direct sunlight.

2. Loss of bleed water and surface drying shall be allowed to proceed naturally. Means to accelerate drying such as applying dry cement, sand, or other materials shall be prohibited.

B. Floor Flatness and Floor Levelness

1. Elevated floor slabs constructed on formwork and all concrete tank base slabs shall be true to the gradient and elevation shown on the Drawings. Flat Slabs shall be level with a tolerance of 1/8 inch in 10 feet. Sloped slabs shall be true to the gradient shown, within a tolerance of 1/8 inch in 10 feet. Slabs shall be pitched to drains as indicated on the Drawings.

C. Floated Finish

1. Slabs to receive a seamless floor finish or roofing, and all tank bottom slabs, shall receive a floated finish. Floating shall also precede a troweling, where a troweled finish is required as specified below. After consolidating, screeding, and leveling, the slab shall not be worked further until it is ready for floating.

2. Floating shall begin when the water sheen has disappeared, and when the slab has stiffened sufficiently to allow proper operation of a power-driven float. Hand floating with wood, aluminum or magnesium floats shall be used at locations inaccessible to the power-driven float.

3. Surface trueness shall be verified at this stage with a 10-foot straightedge applied in multiple angles. High spots shall be cut down and low spots filled so that the finished surface is true. The slab shall then be immediately refloated to a uniform, smooth, granular texture.

D. Troweled Finish

1. All interior slabs left exposed shall receive a troweled finish.

2. The surface shall be finished with power floats as specified above for floated finish, followed by power trowels, and finally hand trowels. The first power troweling shall produce a smooth surface relatively free of defects but which may contain trowel marks. Subsequent trowel shall be by hand after the surface has sufficiently hardened. The surface shall be thoroughly consolidated by the hand troweling, and final troweling shall be done when a ringing sound is produced as the trowel is moved over the surface. The finished surface shall be free of trowel marks and uniform in texture and appearance.

3. Interior concrete slabs to be hard-troweled shall have a maximum air content of 3.0 percent. After the curing period, they shall be protected from freezing temperatures for a minimum of 8 weeks. Thereafter, and for the duration of the Contract, if such slabs might be subject to freezing temperatures, they shall be fully sheltered from rain, snow and all other water sources.

4. Subsequent trowels shall be by hand after the surface has sufficiently hardened. The surface shall be thoroughly consolidated by the hand troweling, and final troweling shall be done when a ringing sound is produced as the trowel is moved over the surface. The finished surface shall be free of trowel marks and uniform in texture and appearance.

E. A broom finish shall be provided for all exterior slabs, sidewalks, platforms, ramps, exterior stairs and as specified or shown on the Drawings. After floating, and between initial and final set, the surface shall be given a coarse transverse scored texture by drawing a broom across the surface.

F. Raked finish: after consolidating, screeding and leveling, the surface shall be roughened with stiff brushes or raked before final set. At sloped surfaces scratches shall be made parallel to the direction of slope, to facilitate subsequent cleaning.

G. A wood float finish, a broom finish with open pores, or a finish as otherwise required by the waterproofing manufacturer shall be provided for concrete slabs that will receive a wet slurry application of cementitious waterproofing.

3.09 CLEANING CONCRETE

A. Cleaning during progress of the Work shall not be permitted. Cleaning shall not commence until the structure is entirely completed.

B. Rust and other stains and discolorations shall be removed with a non-etching cleaning agent used in accordance with the manufacturer's instructions. Cleaning of all surfaces to receive a painted finish is also required.

C. Rust stains may be removed by applying a bleaching agent such as oxalic acid. Acid etching, sandblasting, or cleaning by other methods may be used as approved by the Engineer.

3.10 FIELD QUALITY CONTROL

A. General:

1. Provide in accordance with Division 01 General Requirements. Comply with applicable reference standards listed in Article 1.03.

2. During the progress of the Work, an independent, accredited and certified testing laboratory shall conduct concrete testing as specified, including the preparation and testing of concrete cylinders. All testing shall be paid for by the Contractor.

3. Field technicians in charge of sampling concrete; testing for slump, unit weight, air content, and temperature; and making and curing test specimens shall be certified in accordance with the requirements of ACI Concrete Field Testing Technician – Grade 1 certification program, or the requirements of ASTM C1077.

4. Scheduling: advise testing laboratory and field technician(s) a minimum 24 hours in advance of placing concrete to allow for scheduling observation and testing.

5. Test Cylinder Storage: Provide space and electrical power at the Site for temperature controlled storage of concrete laboratory test cylinders to be standard cured per Section 03 30 00. Temperature controlled storage containers to be provided by testing agency.

B. Field Testing and Sampling Procedures

1. Concrete samples shall be taken in accordance with ASTM C172 for slump, entrained air, unit weight, and strength tests.

2. Entrained air content and slump requirements are listed in Section 03 30 00.

3. Air Content: Test in accordance with ASTM C173 or ASTM C231. Prior to pumping initial delivery of concrete each day, air content and slump shall be verify at point of delivery. Thereafter, pumped concrete shall be sampled and tested for air content at the point of placement, as opposed to at the point of delivery. Upon the Engineer's approval: once the slump loss and the loss of entrained air due to pumping is established, correlated acceptance limits at the point of delivery, where sampling and testing may then be performed, shall be made applicable. When the pump line configuration is changed significantly, sampling and testing shall again be performed at the point of placement until new acceptance limits at the point of delivery may be determined.

4. Slump: Measured in accordance with ASTM C143 at the point of delivery.

5. Temperature shall be measured in accordance with ASTM C1064 at the point of delivery.

6. Test Cylinders: Concrete cylinders shall be prepared in accordance with ASTM C31 and be 4 inches diameter by 8 inches tall. Number of cylinders required: as specified below.

a. Lab-Cured (Standard Cured) Cylinders: Filed cured in temperature-controlled storage per Section 03 30 00. Cylinders shall be transported to the testing lab within 48 hours of forming, but not sooner than 8 hours after final set.

b. Field Cured Cylinders: Cured in the field under conditions that are not more favorable than the most unfavorable conditions for the portions of the concrete that the cylinders represent.

C. Laboratory Testing of Test Cylinders

1. Cylinders shall be tested for compressive strength in accordance with ASTM C39

2. Test concrete cylinders as specified.

3. The compressive strength shall be the average strength of three cylinder breaks per ASTM C39 and tested at 28-days.

4. Test Results: Submit test results to Engineer and concrete supplier within 24 hours of laboratory testing.

D. Field and Laboratory Testing Frequency

1. Minimum field testing frequency for each day concrete is delivered and placed at the project site shall be as follows.

a. Take concrete test cylinders at frequency stated from truckload determined by technician, Contractor, or Engineer

b. 1st truck load: Test air content, slump, and temperature.

c. 2^{nd} and 3^{rd} truck load: No testing unless noted otherwise.

d. 4^{th} truck load: Test air content, slump, and temperature

e. 5^{th} and 6^{th} truck load: No testing unless noted otherwise

f. 7^{th} truck load: Test air content, slump, and temperature.

g. Repeat test frequency for additional truckloads of concrete delivered during each day of concrete placement.

h. Concrete temperature shall be tested for each truckload of concrete during cold weather or hot weather as defined within this specification.

i. Contractor, Owner's representative, or Engineer shall increase testing frequency as required to verify mix designs, address workability concerns, and to ensure all concrete placed complies with specifications.

2. Lab-Cured (Standard Cure) Cylinders

   a. Lab-cured cylinders are required for all concrete on the project and be in addition to field-cured cylinders, where provided.

   b. One set of 5 cylinders shall be prepared for each 100 cubic yards, or fraction thereof, of each different mix placed in each single day; or for each 5,000 square foot of slab or wall surface area placed each day.

   c. Test one cylinder at 7 days, three at 28 days, and reserve one cylinder for 56-days.

   d. Test 56-day cylinder as needed or requested by Contractor or Engineer.

3. Field-Cured Cylinders

   a. Take additional field-cured test cylinders to verify concrete compressive strength prior to tightness testing concrete tanks, backfilling concrete basement walls, or early removal of formwork.

   b. One set of 3 field-cured cylinders shall be prepared for each 100 cubic yards, or fraction thereof, of the concrete placed in each single day.

   c. Test field cured cylinders at 14 days or as requested by Contractor or Engineer.

E. Acceptance Criteria and Additional Testing Requirements

1. Concrete strength shall be evaluated in accordance with ACI 301 Section 1.6.5, "Evaluation of concrete strength tests", and Section 1.6.6, "Acceptance of concrete strength"

2. Construction will be considered potentially deficient if concrete fails to meet any requirements that affect the strength and durability of the structure, including but not necessarily limited to

   a. Low strength concrete per ACI 301, Section 1.6.5, "Evaluation of concrete strength tests", and Section 1.6.6, "Acceptance of concrete strength"

   b. Water-to-cementitious materials ratio higher than that of the specified mix

   c. Reinforcing steel size, quantity, strength, position or arrangement that does not meet the requirements of the Contract Documents

d. Reinforced concrete that differs from the dimensions or locations shown on the Drawings

e. Curing that does not meet the requirements of the Contract Documents, including premature formwork removal

f. Hot or cold weather concreting that doesn't meet the requirements of the Contract Documents

g. Mechanical damage from accidents or fire

h. Poor construction practices

F. Engineer may order load and/or core tests in accordance with ASTM C42. Such testing shall be paid for by the Owner if the concrete is proven to meet the requirements specified.

3.11 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 05 50 00

METAL FABRICATIONS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide metal fabrications in accordance with this Section and applicable reference standards listed in Article 1.03.

B. Related Requirements

1. Section 09 90 00 – Painting and Coating

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. American Concrete Institute (ACI)

   a. ACI 355.2 Qualification of Post-Installed Mechanical Anchors in Concrete

   b. ACI 355.4 Qualification of Post-Installed Adhesive Anchors in Concrete Elements

2. American Institute of Steel Construction (AISC)

   a. AISC 303 Code of Standard Practice for Steel Buildings and Bridges

3. American National Standards Institute (ANSI)

   a. A14.3 American National Standard for Ladders-Fixed-Safety Requirements

4. American Welding Society (AWS)

   a. AWS D1.1 Structural Welding Code - Steel

   b. AWS D1.2 Structural Welding Code - Aluminum

   c. AWS D1.6 Structural Welding Code - Stainless Steel

5. ASTM International (ASTM)

   a. ASTM A6 Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling

   b. ASTM A36 Standard Specification for Carbon Structural Steel

   c. ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

   d. ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

   e. ASTM A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

   f. ASTM A239 Standard Practice for Locating the Thinnest Spot in a Zinc (Galvanized) Coating on Iron or Steel Articles

   g. ASTM A500 Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

   h. ASTM A563 Standard Specification for Carbon and Alloy Steel Nuts

   i. ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

   j. ASTM A780 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

   k. ASTM A992 Standard Specification for Structural Steel Shapes

   l. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

   m. ASTM B211 Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire

   n. ASTM B308 Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles

   o. ASTM D6386 Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting

   p. ASTM F436 Hardened Steel Washers

q. ASTM F1136 Standard Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners

r. ASTM F1554 Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

s. ASTM F2329 Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

t. ASTM F2833 Standard Specification for Corrosion Protective Fastener Coatings with Zinc Rich Base Coat and Aluminum Organic/Inorganic Type

u. ASTM F3125 Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength, Inch and Metric Dimensions

6. ICC Evaluation Services (ICC-ES)

a. ICC-ES AC58 Acceptance Criteria for Adhesive Anchors in Masonry Elements.

b. ICC-ES AC308 Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.

7. National Association of Architectural Metal Manufacturers (NAAMM)

a. AMP 500 Metal Finishes Manual

b. MBG 531 Metal Bar Grating Manual

c. MBG 533 Welding Specification for Fabrication of Steel, Aluminum, & Stainless-Steel Bar Grating

8. Research Council on Structural Connections (RCSC)

a. Specification for Structural Joints Using High-Strength Bolts

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Shop Drawings

1. Details of connections, copes, splices, holes, hardware, finish, and other pertinent information

2. Anchor bolt embedment drawings

3. Indicate welds by standard AWS symbol

4. Indicate bolts and identify slip-critical connections as applicable

5. Identify areas of slip-critical connections to be masked from shop painting

C. Product Data

1. Expansion Bolts

a. ICC-ES Compliance Report

b. Allowable and ultimate load tables per embedment depths

c. Capacity reduction factors for bolt spacing and edge distances

d. Installation Instructions including bolt torque

2. Adhesive Anchors

a. ICC-ES Compliance Report

b. Allowable and ultimate load tables per embedment depths

c. Storage requirements

d. Gel and cure times as a function of temperature

e. Installation temperature requirements

f. Drilling method

g. Drill bit diameter and depth of hole for each size anchor

h. Hole cleaning procedure and required condition of hole

i. Dual-nozzle instructions to ensure proper mixing

j. Hole Filling procedure

k. Time period anchor cannot be contacted or disturbed

D. Samples and Mockups: as specified in Article 1.06.

E. Manufacturer Instructions

F. Source and Field Quality Control Submittals

G. Certificates

1. Mill test reports for structural shapes, bolts, nuts, and washers

2. Welding certifications for welding procedures and personnel

3. ACI/CRSI Adhesive Anchor Installer Certification or equivalent as approved by the Engineer, for installation of adhesive anchors horizontally or upwardly inclined to resist sustained tension loads.

H. Closeout and maintenance material submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Samples

1. Railings indicating weld, splicing, and finish

2. Stair nosing

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Assemble and ship ASTM F1852 and galvanized ASTM F3125 bolt assemblies in the same container. Do not re-lubricate ASTM F1852 tension-control bolt assemblies.

C. Carefully unload material and equipment and stack to prevent deformation and damage. Store items on substantial pallets, dunnage, or other supports and spacers, free from the earth and properly drained, preventing splattering with dirt and other foreign matter.

D. Store material and equipment to permit easy access for inspection and identification. Protect from deterioration and maintain markings.

E. Provide protective storage for fastener components. Protect fastener components removed from protective storage from dirt and moisture in closed containers at the location of installation. Do not clean or modify fastener components from as-delivered condition. Do not use fastener components accumulating rust or dirt, and remove from the Site.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

1.09 WARRANTY

A. Special Warranty/Extended Correction Period

1. Hatch covers: 5-year manufacturer's warranty covering proper operation and defects in material or workmanship.

PART 2 – PRODUCTS

2.01 GENERAL

A. Make field measurements prior to fabrication to ensure proper fit. Report discrepancies in existing conditions that require detail changes to Engineer prior to fabrication.

B. Assemble built-up Work in sections in the shop as much as practicable and match mark components for field assembly.

C. Bolt holes (including those for attaching wood blocking and other components): by fabricator and not made or modified by burning.

D. Gauges

1. Iron sheets and steel: U.S. Standard

2. Acceptable level of quality for non-ferrous products: equivalent to Brown & Sharpe.

3. Wire: U.S. Steel Wire.

E. Weld carbon steel per ANSI/AWS D1.1, with electrodes with a tensile strength of 70 ksi.

F. Fusion weld aluminum by the inert gas-shielded arc method per ANSI/AWS D1.2. Use alloy rods similar to alloy being welded where appearance match is required. Alloy 4043 rods may be used where appearance is not a factor and anodizing is not required.

G. Weld stainless steel per AWS D1.6.

H. Steel

1. Comply with AISC 303.

2. Steel mill material tolerances: per ASTM A6.

3. Steel W-shapes: ASTM A992 (50 ksi yield strength).

4. Steel channels and angles: ASTM A992 (50 ksi yield strength) ASTM A572 grade 50, or ASTM A36.

5. Other steel shapes, plates and bars: ASTM A36.

6. Steel pipe: ASTM A53, Grade B.

7. Hollow structural shapes: ASTM A500, Grade B.

I. Bolts: ASTM F3125 Grade A325 Type I, heavy-hex, hot-dipped galvanized per ASTM F2329 at exterior applications and/or where indicated on Drawings.

J. Nuts: ASTM A563, heavy-hex.

K. Washers: ASTM F436 hardened steel.

L. Tension-control bolt assemblies: ASTM F1852 Type I, heavy-hex.

M. Direct tension indicators: ASTM F959, Type 325, compressible washer type.

N. Threaded rods: ASTM A36.

O. Aluminum items: Fabricated from bars, plates, pipes, rolled and extruded shapes conforming to the following alloy designation unless otherwise specified.

1. Standard structural shapes: Rolled 6061-T6 per ASTM B308.

2. Rolled rod and bar: 6061-T6 per ASTM B211.

3. Sheets, Plates, Checkered Plates: 6061-T6 per ASTM B209.

4. Bolts: 2024-T4.

5. Nuts: 6061-T6.

6. Washers: Alclad 2024-T4.

P. Stainless steel items: Type 316 (Type 316L if welded).

2.02 ALUMINUM GRATINGS AND FRAMES

A. Manufacturers: IKG Industries, Klemp Corporation, Ohio Gratings, Inc., or equal.

1. Grating: I-bar swage locked with 1/4 inch flanged bars at 1-3/16 inches on center and cross bars at 4 inches on center per NAAMM AMP 500, NAAMM MBG 531, and NAAMM MBG 533.

2. Supporting members: Aluminum of size and shape per Drawings.

3. Grating: Alloy 6063-T6 bearing bars and alloy 6063-T5 cross bars with mill finish.

4. Straps, bolts, ties, and accessories: Aluminum

5. Band grating with 1/4-inch thick band of width equal to the full depth of grating, welded on at the ends of all sections and at openings.

6. Where not shown, provide suitable supporting members as required when span of grating changes direction.

B. Fasteners: manufacturer's standard clips using micarta between the aluminum and dissimilar materials. Provide one fastener at each section corner, and a minimum of one additional fastener for each intermediate support.

C. Coat portions of aluminum to be embedded in, or in contact with, concrete with heavy bodied bituminous paint.

D. Limit grating sections to a size that can be removed by one person.

2.03 STEEL FRAMES FOR MISCELLANEOUS OPENINGS

A. Fabricate from structural shapes and plates in sizes per Drawings.

B. Accurately square, miter, butt, or cope frames. Weld flush and grind smooth.

C. Stops: plug-welded and ground smooth.

D. Seal weld joints exposed to weather.

2.04 EXPANSION BOLTS (INTO CONCRETE)

A. General: torque controlled expansion anchor suitable for seismic loads and cracked concrete applications.

B. Material

1. AISI 316 stainless steel anchor body, nut, washer, and expansion sleeve, unless noted otherwise

C. Evaluation requirements: ICC-ES evaluation report stating product is compliant with 2015 International Building Code and approved for use to resist static, wind and earthquake (Seismic Design Categories A through F) tension and shear loads in cracked and uncracked normal-weight concrete having a compressive strength of 2,500 psi to 8,500 psi. Evaluation reports with a listed renewal date month/year which is prior to the month/year the product is submitted for engineer's review will be rejected.

D. Expansions bolts

1. Simpson Strong-Tie: Strong-Bolt 2

a. Compliance Report (ESR-3037)

2. Hilti: Kwik Bolt TZ

a. Compliance Report (ESR-1917)

3. Powers: Power-Stud + SD6

a. Compliance Report (ESR-2502)

4. Or equal

2.05 ADHESIVE ANCHORS (INTO CONCRETE)

A. Epoxy adhesive for installing post-installed bolts into concrete denoted as adhesive anchors on Drawings.

B. Evaluation requirements: ICC-ES evaluation report stating product is compliant with International Building Code and approved for use to resist static, wind and earthquake (Seismic Design Categories A through F) tension and shear loads in cracked and uncracked normal-weight concrete having a compressive strength of 2,500 psi to 8,500 psi. Evaluation reports with a listed renewal date month/year which is prior to the month/year the product is submitted for engineer's review will be rejected.

C. Epoxy adhesive for anchoring reinforcement to concrete shall be a 2 component solid epoxy based system supplied in manufacturer's standard side-by-side cartridge and dispensed through manufacturer's standard static-mixing nozzle.

1. Simpson Strong Tie: SET-3G or ET-HP

a. SET-3G Compliance Report (ESR-4057)

b. ET-HP Compliance Report (ESR-3372)

2. Hilti: HIT-RE 500 V3

a. Compliance Report (ESR-3814)

3. Dewalt: PE1000+

a. Compliance Report (ESR-2583)

4. Or equal

D. Epoxy adhesive to pass the creep test requirements of ICC-ES AC308.

E. Provide hardware from same manufacturer as epoxy adhesive for a complete anchoring system.

1. Threaded steel rods: continuously threads (all-thread).

2. Material: AISI 316 stainless steel threaded steel rods, nut and washers, unless noted otherwise.

2.06 ADHESIVE ANCHORS (INTO MASONRY)

A. Adhesive anchor system for installing post-installed threaded steel rods to grouted and ungrouted CMU, solid and hollow brick walls, and unreinforced multiple wythe brick walls denoted as “Adhesive Anchors” on drawings.

1. All products to be furnished by the same manufacturer including steel threaded rods, mesh screen tubes, adhesive, and installation equipment.

B. Evaluation requirements: ICC-ES evaluation report stating product is compliant with 2015 International Building Code and approved to anchor building components to hollow (ungrouted) and fully grouted concrete masonry walls to resist static, wind , and earthquake loads.

C. Adhesive for anchoring reinforcement to masonry shall be furnished in a side-by-side cartridge and dispensed through manufacturer's standard static-mixing nozzle. Adhesive system shall be:

1. Simpson Strong Tie: SET-3G or ET-HP

a. SET-3G Compliance Report (ESR-4844)

b. ET-HP Compliance Report (ESR-3638)

2. Hilti: HIT-HY 270

a. Compliance Report (ESR-4143)

3. Dewalt: AC100+ Gold

a. Compliance Report (ESR-3200)

4. Or equal

D. Epoxy adhesive to pass the creep test requirements of ICC-ES AC58.

E. Provide hardware from same manufacturer as epoxy adhesive for a complete anchoring system.

1. Threaded steel rods: continuously threads (all-thread).

2. Material: AISI 316 stainless steel threaded steel rods, nut and washers, unless noted otherwise.

3. Screen Tubes / threaded insets: manufacturer's standard screen tubes or threaded inserts.

2.07 LADDERS

A. Aluminum Ladders

1. Material: Alloy 6061-T6 with 2-1/2 inch by 3/8 inch flat bar side rails and alloy 6063-T5 aluminum 1-inch square corrugated or other approved skid proof rungs.

2. Rails: bracketed for wall areas at no greater than 4 feet centers.

3. Center of the rungs 7 inches from the face of walls.

4. Ladders and safety cages: Per ANSI A14.3 and OSHA.

B. Steel Ladders

1. Material: ASTM A36 steel with 2-1/2 inches by 3/8 inch flat bar side rails and 1 inch square, or other approved rungs.

2. Cover each rung with 1-inch wide anti-slip high traction course safety tape with silicon carbide black grit. Acceptable level of quality: equivalent to #NS5301B by No Skidding Product, Inc.

3. Rails: bracketed for wall areas at no greater than 4 feet centers.

4. Center of the rungs 7 inches from the face of walls.

5. Ladders and safety cages: per ANSI A14.3 and OSHA.

2.08 ALUMINUM HATCH COVERS

A. Manufacturers: Bilco Company, Halliday Products, Inc., Babcock-Davis, or equal.

1. Type K and KD: single leaf and double leaf, respectively.

a. Door leaf: 1/4-inch thick aluminum diamond pattern plate reinforced with aluminum stiffeners, capable of withstanding live load of 150 pounds per square foot. Equip door leaf with minimum 2 hinges bolted to underside and pivoted on torsion bars to counterbalance door for easy operation.

b. Provide automatic hold-open arm at 90-degree open position, with vinyl grip handle to release cover for closing.

c. Equip with snap lock and removable handle.

d. Channel frame: 1/4-inch thick extruded aluminum with built-in neoprene cushion and strap anchors.

e. Hardware: stainless steel with factory mill finish.

f. Bituminous coating applied to areas to be embedded in concrete.

g. Hardware

1) Heavy pintle hinges shall be provided

2) Cover to be equipped with a spring latch with interior and exterior turn handles

3) Roof hatch to be equipped with interior and exterior padlock hasps.

4) Latch strike to be a stamped component bolted to the curb assembly.

5) Cover to automatically lock in the open position with a rigid hold open arm equipped with a 1-inch diameter red vinyl grip handle to permit easy release for closing.

6) Compression spring tubes to be an anti-corrosive composite material and all other hardware to be 316 stainless steel.

7) Cover hardware to be bolted into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.

2. Factory finish to be mill finish aluminum.

B. Fall protection

1. Equip hatch covers with fall protection grating system of fiberglass or aluminum construction and 316 stainless steel hardware, with live load capacity of 300 psf.

2. Safety color: orange or yellow.

3. Provide with spring-loaded lifting handle and aluminum or stainless steel hold open arm and release handle, and automatic lock at 90-degree open position.

4. Provide capability for locking with padlock in the closed position.

2.09 MISCELLANEOUS STEEL ITEMS

A. Fabricate and furnish miscellaneous steel items, galvanized angles, relieving angles, plates, channels, and required fastenings per Drawing details. Miscellaneous steel items to be galvanized as specified.

2.10 ANCHOR BOLTS

A. ASTM F1554 Grade 36 steel, galvanized except where stainless steel specified, headed and threaded.

B. Type 316 stainless steel: to attach aluminum and in all submerged locations – including washers and nuts.

C. Sizes: per Drawings

2.11 SHOP COATING

A. Prepare ferrous items and paint per Section 09 90 00

B. Do not prime paint galvanized steel not specified to be painted, stainless steel surfaces embedded in concrete or masonry (except for partially embedded components, extend priming 2 inches into the embedment), surfaces to be field welded, and faying surfaces at bolted connections designated as slip-critical.

C. Coat items specified as galvanized by the hot-dip process per ASTM A123, ASTM A153, or ASTM A653, as applicable, in molten zinc, to produce a continuous coating of uniform thickness of weight required by the referenced standards.

1. Coating: commercial quality, free from injurious defects, flux and uncoated spots, and per ASTM A239: capable of enduring not less than 4 immersions in copper sulfate without penetration of the coating.

2. Identify galvanized items with a stamp showing name of the galvanizer, the weight of the coating, and applicable ASTM compliance.

D. Galvanized steel specified to be painted

1. Do not quench.

2. Phosphatize and prepare to be painted per ASTM D6386

3. Prime with paint compatible with finish paints specified in Section 09 90 00.

2.12 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 DISSIMILAR MATERIAL

A. Keep aluminum surfaces from direct contact with metals other than stainless steel by painting the dissimilar metal with a coating of zinc chromate paint, or provide non-absorptive tape between dissimilar metals.

B. Paint aluminum with a coat of bituminous paint where aluminum is embedded in, or comes in contact with, concrete, masonry or by-products of these materials.

3.02 STEEL CONNECTIONS

A. Comply with RCSC Specifications for Structural Joints Using ASTM F3125 Grade A325 or A490 Bolts.

B. Design bolted connections as N-type bearing connections, installed snug-tight, except where shown as slip critical on Drawings.

C. Minimum size: 3/4 inch.

D. Minimum number of bolts per connection: 2.

E. Slip critical joints are required per Drawings and at connections that include oversized holes or slotted holes, including braces, except where the direction of the load is normal to the slot.

F. Where bolts are specified to be installed loose or finger tight, snug up the connection to ensure that plies are in contact. Then back off the nut between 1/2 and 1 turn to permit intended movement of the connection. Provide double nuts on bolts to prevent loosening.

G. Weld steel per AWS D1.1. Grind exposed welds smooth.

3.03 INSTALLATION

A. Verify elevations of concrete and masonry bearing surfaces and locations of anchor rods, bearing plates, and other embedments. Clean concrete and masonry bearing surfaces of bond reducing materials and roughen surfaces prior to setting plates.

B. Use stainless steel hardware when anchoring aluminum and in submerged locations.

3.04 BOLTS

A. Install bolts snug tight except where indicated as slip critical. Install bolt at least flush with the outer face of the nut. Cut off bolts projecting more than 5/8 inch beyond the nut in exposed Work as close to nut as possible and as directed.

B. Joint surfaces to be free of loose mill scale, burrs, and foreign material. Enough bolts to be brought to a snug tight condition to ensure the parts of the joint are properly compacted. Following the initial tightening, place bolts in any remaining holes in the connection and brought to snug tightness. Tighten bolts in the joint an additional 1/3 turn if bolt length is up to and including four bolt diameters, or a 1/2 if longer.

C. Provide required cutting, fitting, drilling, and tapping. Do not use thermal cutting during installation and erection. Do not make or modify bolt holes by burning.

3.05 ADHESIVE BOLTS

A. Installation: per manufacturer's installation instructions and as listed in the product ICC-ES Evaluation Report

B. Drilled and epoxied bolts shall be installed in concrete having a minimum age of 21 days at time of installation.

C. Cartridges to have expiration date clearly visible. Material past its expiration date may not be used and immediately removed from Site.

D. Diamond drill bits not permitted. Hammer drills may be used.

E. Drill Holes

1. Diameter: per manufacturer's instructions.

2. Embedment: manufacturer's standard embedment for anchor size, unless otherwise noted on Drawings. Do not use depth stop to ensure correct drilling depth.

3. Installation torque: per manufacturer's instructions.

F. Discard initial material extruded from each cartridge in accordance with manufacturer's instructions to ensure material is properly mixed.

G. Drilled holes to be blown out with air, thoroughly wire brushed with a repeated back and forth movement, blown out, thoroughly wire brushed, and blown out again. Adhesive to be injected, starting from the bottom of the hole and slowly withdrawn as filling progresses to prevent air pockets.

H. Installed bolt to remain completely undisturbed between the manufacturer's specified gel time and full cure time. Apply zero load during this time.

3.06 EXPANSION BOLTS

A. Installation: per manufacturer's installation instructions and as listed in product ICC-ES Evaluation Report.

B. Drill Holes

1. Diameter: per manufacturer's instructions.

2. Embedment: manufacturer's standard embedment for anchor size, unless otherwise noted on Drawings. Use depth stop to ensure correct drilling depth.

C. Installation torque: per manufacturer's instructions.

3.07 FIELD TOUCH UP

A. Where galvanized steel is field cut and locations where galvanized coating is removed: Touch up steel surface with zinc rich paint meeting ASTM A780 and containing a minimum of 65 percent zinc at locations.

3.08 CLEANING

A. Immediately after installation, round or chamfer sharp edges and grind burrs, jagged edges and surface defects smooth. Remove weld splatter.

3.09 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.10 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 09 90 00

PAINTING AND COATING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide surface preparation and painting in accordance with this Section and applicable reference standards listed in Article 1.03.

2. Provide the following types of painting work per the Paint Schedules attached and on Drawings:

a. Painting and labeling of ductile iron pipes

b. Painting of equipment where indicated, and labeling of all equipment

c. Touch-up painting of factory-coated equipment

B. Related Requirements

1. Section 05 50 00 – Miscellaneous Metals

2. Section 40 05 13 – Process Pipe and Fittings

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. ASTM International (ASTM)

a. ASTM A780 Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

b. ASTM D4414 Standard Practice for Measurement of Wet Film Thickness by Notch Gages

c. ASTM D4417 Standard Test Method for Field Measurement of Surface Profile of Blast Cleaned Steel

d. ASTM D6386 Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Products and Hardware Surfaces for Painting

e. Subfloor Using Anhydrous Calcium Chloride

2. NACE International, (NACE)

a. NACE Publication 6D-173 A Manual for Painter Safety

b. NACE SP0178 Surface Finishing of Welds Prior to Coating

3. The Society for Protective Coatings (SSPC)

a. SSPC-Paint 16, Coal Tar Epoxy-Polyamide

b. SSPC-Paint 20, Zinc-Rich Coating Inorganic and Organic

c. SSPC-SP12/NACE 5 Surface Preparation and Cleaning of Steel and Other Hard Materials by High and Ultra High-Pressure Jetting Prior to Recoating

d. SSPC-Guide 12 Guide for Illumination of Industrial Painting Projects

e. SSPC-VIS-1 Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning

B. Definitions

1. Surface Preparation of Carbon Steel per SSPC Surface preparation Standards. Definitions below summarize surface preparation requirements for each level of cleaning. Refer to SSPC standards for complete requirement for each level of surface preparation and cleaning.

a. Adherent: Mill scale, rust and coating are considered tightly adherent if they cannot be lifting with a dull putty knife.

b. SSPC-SP1: Solvent Cleaning: The removal of all visible oil, grease, soil, drawing and cutting compounds and other soluble contaminants from surfaces with solvents or commercial cleaners using various methods of cleaning such as wiping, dipping, steam cleaning or vapor degreasing.

c. SSPC-SP2: Hand Tool Cleaning: The removal of all loose mill scale, loose rust, loose paint and other loose detrimental foreign matter by the use of non-power hand tools.

d. SSPC-SP3: Power Tool Cleaning: The removal of all loose mill scale, loose rust, loose paint and other loose detrimental foreign matter by the use of power-assisted hand tools.

e. SSPC-SP5/NACE 1: White Metal Blast Cleaning: The complete removal of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products and other foreign matter by compressed air nozzle blasting, centrifugal wheels or other specified methods.

f. SSPC-SP6/ NACE 3: Commercial Blast Cleaning: The complete removal of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products and other foreign matter by compressed air nozzle blasting, centrifugal wheels or other specified methods. Discoloration caused by certain stains shall be limited to no more than 33 percent of each unit area. Unit area is approximately 9 sq in.

g. SSPC-SP7 / NACE Brush-off Blast Cleaning: A brush-off, blast-cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, loose mill scale, loose rust and loose coating. Tightly adhered mill scale, rust and coating may remain on the surface.

h. SSPC-SP10 / NACE 2 Near-White Metal Blast Cleaning: The removal of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products and other foreign matter by compressed air nozzle blasting, centrifugal wheels or other specified method. Discoloration caused by certain stains shall be limited to no more than 5 percent of each unit area. Unit area is approximately 9 sq. in.

i. SSPC-SP11 Power Tool Cleaning to Bare Metal: The removal of all visible oil, grease, dirt, mill scale, rust, paint, oxide, corrosion products, and other foreign matter. Slight residues of rust and paint may be left in the lower portion of pits if the original surface is pitted. Differs from SSPC-SP3 in that is requires more thorough cleaning and a surface profile not less than 1 mil (25 microns).

2. SSPC-SP12 / NACE 5 Pressure Categorization

a. Water Jetting: Use of water at high or ultrahigh-pressure to prepare a surface for recoating using pressure above 10,000 psi. Water jetting will not produce a profile; rather it exposes the original abrasive-blast surface profile.

b. Low-Pressure Water Cleaning (LP WC): Cleaning performed at pressures less than 5,000 psi.

c. High-Pressure Water Cleaning (HP WC): Cleaning performed at pressures from 5,000 psi to 10,000 psi

d. High-Pressure Water Jetting (HP WJ): Cleaning performed at pressures from 10,000 psi to 25,000 psi.

e. Ultra-High-Pressure Water Jetting (UHP WJ): Cleaning performed at pressures above 25,000 psi.

3. SSPC-SP12 / NACE 5 Visual Conditions of Surface Cleanliness:

a. Water jetting shall be performed to meet one of the following four conditions: WJ-1, WJ-2, WJ-3, WJ-4, and a minimum acceptable surface shall have all loose rust, loose mill scale, and loose coatings uniformly removed.

b. WJ-1: Surface shall be free of all previously existing visible rust, coatings, mill scale, and foreign matter and have a matte metal finish.

c. WJ-2: Surface shall be cleaned to a matte finish with at least 95% of the surface area free of all previously existing visible residues and the remaining 5% containing only random dispersed stains of rust, coatings, and foreign matter.

d. WJ-3: Surface shall be cleaned to a matte finish with at least two-thirds of the surface free of all previously existing visible residues (except mill scale), and the remaining one-third containing only randomly dispersed stains of previously existing rust, coatings, and foreign matter.

e. WJ-4: Surface shall have all loose mill scale, and loose coatings uniformly removed.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data

1. Block Fillers

2. Primers

3. Manufacturer's technical information including label analysis and instructions for handling, storage, and application of each material proposed for use.

4. Manufacturer's material data and certificates of performance for proposed substitutions.

5. List each material and cross-reference the specific coating, finish system, and application. Identify each material by the manufacturer's catalog number and general classification.

C. Samples and Mockups: as specified in Article 1.06.

1. Provide Samples for initial color selection in the form of manufacturer's color charts. After color selection, furnish color chips of selections made for surfaces to be coated.

D. Certificates: From manufacturer that products supplied comply with local Regulations controlling use of volatile organic compounds (VOCs).

E. Closeout and maintenance material submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Qualifications: per Division 01 General Requirements for applicators and as follows.

1. Engage experienced applicators who have completed painting system applications similar in material and extent to those indicated for the Project that have resulted in a construction record of successful in-service performance.

C. Samples On wall surfaces and other exterior and interior components, duplicate finishes of prepared Samples. Provide full-coat finish Samples on at least 100 square feet of surface until required sheen, color, and texture are obtained; simulate finished lighting conditions for review of in-place Work.

1. Final acceptance of colors will be from Project-applied Samples.

2. Engineer will select 1 room or surface to represent surfaces and conditions for each type of coating and substrate to be painted. Apply coatings in this room or surface according to the Paint Schedules attached and, on the Drawings, or as specified.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Packing, Shipping, Handling, and Unloading

1. Deliver materials to the Site in the manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information.

a. Product name or title of material

b. Product description (generic classification or binder type)

c. Manufacturer's stock number and date of manufacture

d. Contents by volume, for pigment and vehicle constituents

e. Thinning instructions

f. Application instructions

g. Color name and number

C. Storage and Protection

1. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 degrees F. Maintain containers used in storage in a clean condition, free of foreign materials and residue. Protect from freezing.

2. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and Work areas are protected from fire and health hazards resulting from handling, mixing, and application.

D. Waste Management and Disposal

1. Remove all unused material from the site, unless the Owner requests portions of unused material to be provided in properly sealed containers for future repair and maintenance of coatings. Transport (extra) material to Owner specified storage facility located at the project site.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

1.09 MAINTENANCE

A. Extra Materials: furnish as specified below.

1. Provide Owner the option to retain portions of unused surplus material in properly sealed containers prior to removing from Site for disposal.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Tnemec

B. Sherwin Williams (S&W)

C. PPG

D. Or equal

2.02 PAINT MATERIALS

A. Provide materials designated by item or area to be painted in Paint Schedules attached and on Drawings.

B. Provide primers and undercoat paint produced by the same manufacturer as the finish coats.

C. Provide block fillers, primers, finish coat materials, and related materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by the manufacturer based on testing and field experience.

D. Manufacturer's best-quality trade sale paint material of the various coating types specified. Ensure paint material containers display manufacturer's product identification.

E. Colors from the manufacturer's full range of standard colors.

2.03 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions under which painting will be performed for compliance with paint application requirements. Ensure surfaces receiving paint are thoroughly dry before paint is applied. Do not begin to apply paint until unsatisfactory conditions have been corrected.

B. Coordination of Work: Review other Specifications in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers. Notify Engineer about anticipated problems using the materials specified over substrates primed by others.

3.02 PREPARATION

A. General Requirements

1. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted, or provide surface-applied protection prior to surface preparation and painting. Following completion of painting operations in each space or area, ensure workers skilled in the trades involved reinstall items..

2. Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease prior to cleaning. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

3. Clean and prepare surfaces to be painted according to the manufacturer's instructions for each substrate condition and as specified. Use more stringent cleaning and surface preparation if manufacturer’s recommendations differ from the requirements specified.

   a. Provide barrier coats over incompatible primers or remove and re-prime. Notify Engineer in writing about anticipated problems using the specified finish-coat material with substrates primed by others.

   b. Ensure existing painted surfaces are structurally sound, dry, clean, and free of oil, grease, dirt, mildew, form release agents, curing compounds, efflorescence, loose and flaking paint, or other foreign material. Engineer will approve condition of prepared substrate prior to application of coating system. Test old coatings for lifting per coating manufacturer's recommendations.

4. Abrasive Blast Surfaces: coat before any visible rust forms on the surface. Abrasive blast cleaning shall be performed only when the relative humidity is no higher than 85 percent and the surface temperature of the steel at its coldest point is at least 5 degrees Fahrenheit above the temperature of the dew point. Material that is abrasive blast-cleaned shall be primed in the same shift, no more than 12-hours after the surfaces have been blast-cleaned.

B. New or Previously Uncoated Surfaces

1. Prepare to be painted by removing efflorescence, chalk, dust, dirt, grease, oils, loose rust, and release agents.

a. Ferrous Metals: prepare metal according as follows.

1) Structural steel, steel bar joists, and miscellaneous metal used for interior building framing components that are not exposed to view and are not scheduled to be field painted: SSPC-SP2 prior to shop coat with fabricator's standard primer.

2) Submerged components: sandblasted clean in accordance with SSPC-SP10/NACE 2, near-white blast cleaning immediately prior to priming.

3) All other ferrous metals: sandblasted clean in accordance with SSPC-SP-6, commercial grade, immediately prior to priming.

2. Clean galvanized surfaces with non-petroleum-based solvents so that the surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods in accordance with ASTM D6386.

C. Previously Coated Surfaces

1. Prepare to be painted by removing efflorescence, chalk, dust, dirt, grease, oils, loose rust, and release agents.

a. Ferrous metals including structural steel columns and beams: SSPC-SP7 Brush-Off Blast Cleaning to remove all dirt, loose rust, and loose coatings.

2. Check for coating compatibility by applying a test patch of the recommended coating system, covering at least 2-3 square feet. Allow to dry one week before testing adhesion per ASTM D3359. If the coating is incompatible contact Engineer and coating manufacturer for recommendations.

3. Over-coating of hard, high-gloss, or existing epoxy coatings. Overcoating mechanical equipment or other surfaces that would otherwise be damaged by water cleaning or abrasive blast cleaning.

    a. Clean existing coating with degreaser or other cleaner recommended by coating manufacturer.

    b. Remove damaged, delaminated, or questionable portions of existing coat from the substrate.

    c. Sand, grind, or abrasive blast existing coating to clean and texture surface to improve bond of over-coat.

3.03 COLOR SELECTION

A. Colors of finish coats: as indicated or specified or as selected by Owner.

3.04 APPLICATION

A. General

1. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 degrees F and 90 degrees F.

2. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 degrees F and 95 degrees F.

3. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or to damp or wet surfaces. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.

4. Priming Abrasive Blast Surfaces: Shall be primed before any visible rust forms on the surface. Abrasive blast cleaning shall be performed only when the relative humidity is no higher than 85 percent and the surface temperature of the steel at its coldest point is at least 5 degrees Fahrenheit above the temperature of the dew point. Material that is abrasive blast-cleaned shall be primed in the same shift, no more than 12-hours after the surfaces have been blast-cleaned.

5. Carefully mix and prepare paint materials according to manufacturer's directions.

    a. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.

b. Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.

6. Use only thinners approved by the paint manufacturer and only within recommended limits

7. Apply paint according to manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

   a. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.

   b. Paint colors, surface treatments, and finishes as indicated in the Paint Schedules.

   c. Provide finish coats that are compatible with primers used.

   d. The number of coats and the film thickness required are the same regardless of the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. Sand between applications where sanding is required to produce a smooth even surface according to the manufacturer's directions.

   e. Apply additional coats if undercoats, stains, or other conditions show through final coat of paint until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed surfaces/fasteners, receive a dry film thickness equivalent to that of flat surfaces.

   f. The term exposed surfaces includes areas visible when permanent or built-in fixtures, convector covers, covers for finned tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.

   g. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.

   h. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint.

i. Paint backsides of access panels and removable or hinged covers to match exposed surfaces.

j. Finish exterior doors on tops, bottoms, and side edges same as exterior faces.

k. Sand lightly between each succeeding enamel or varnish coat.

l. Omit primer on metal surfaces that have been shop-primed and touch-up painted.

B. Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. Allow sufficient time between successive coats to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.

C. Apply paints and coatings by brush, roller, spray, or other applicators according to the manufacturer's directions.

1. Use brushes best suited for the material applied.

2. Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.

3. Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.

D. Apply materials no thinner than the manufacturers’ recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.

E. Paint only mechanical and electrical work exposed in mechanical equipment rooms and in occupied spaces and paint mechanical, electrical, HVAC, process equipment, and other utility items as indicated on the Drawings. Do not paint items that are factory painted. Factory applied coating systems are specified in the Specification where the product or item is specified. Items to be painted include:

1. Piping

2. Pumps

3. Heat exchangers

4. Tanks

5. HVAC ductwork

6. Insulation

7. Supports

8. Motors and mechanical equipment

9. Accessory items

F. Ferrous metals indicated on Drawings to be painted will be provided with a shop primer compatible with the coatings specified. Paint ferrous metals specified in Section 05 50 00 that are not galvanized and indicated to be painted on the Drawings.

3.05 PRIME COATS

A. Before applying finish coats, apply a prime coat of material as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime-coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing. Apply prime coat to previously painted surfaces if finish coats are not compatible with existing coating.

3.06 PIGMENTED (OPAQUE) FINISHES

A. Completely cover to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

3.07 PIPE, VALVE/EQUIPMENT IDENTIFICATION AND COLOR CODING

A. Provide identification of pipes, valves and pumps by color as specified in the Section 40 05 13. Color selections for each system shall be provided by the Engineer and Owner.

3.08 COMPLETED WORK

A. Match approved Samples for color, texture, and coverage. Remove, refinish, or repaint Work not complying with specified requirements.

3.09 CLEANING

A. At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the Site. Clean up debris resulting from Work and dispose in Project on-site trash receptacles.

B. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

3.10 PROTECTION

A. Protect Work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as acceptable to Engineer.

B. Provide Wet Paint signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their Work after completing painting operations..

C. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.11 REPAIR

A. Hot-dip Galvanized Surfaces

1. Field repair all damaged hot-dip galvanized coatings.

2. Work shall conform to ASTM A780.

B. Coatings

1. Repair any damaged shop applied primers and coatings as required to provide the same level of protection as provided by undamaged coating systems.

2. Color and finish of repairs shall match adjacent undamaged coating.

3.12 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

B. Site/Field tests and inspections: May be required by Owner up to 4 times during the period when paint is being applied.

1. Engage the services of an independent testing agency with minimum 5 years of experience to sample the paint material used. Provide that Samples of material delivered to the Project are taken, identified, sealed, and certified in the presence of the Contractor.

2. The independent testing agency shall perform appropriate tests at no additional cost to the Owner for the following characteristics:

   a. Quantitative materials analysis

   b. Abrasion resistance

   c. Apparent reflectivity

   d. Flexibility

   e. Washability

   f. Absorption

   g. Accelerated weathering

   h. Dry opacity

   i. Accelerated yellowness

   j. Recoating

   k. Skinning

   l. Color retention

   m. Alkali and mildew resistance

3. If test results show material being used does not comply with specified requirements, stop painting, remove noncomplying paint, repaint surfaces coated with rejected paint, and remove rejected paint from previously painted surfaces if, upon repainting with specified paint, the two coatings are incompatible

3.13 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

3.14 ATTACHMENTS

A. Paint Schedule

END OF SECTION

PAINT SCHEDULE

Number of coats scheduled is as a minimum. Painting and finishing shall conform to applicable Laws and building code regarding fire hazard classifications and volatile organic content of finish materials. Products listed shall not be in-contact with Potable Water and do not comply with NSF/ANSI 61. Provide products by the manufacturers named or approved equal.

Refer to Drawings and equipment specifications for item to be painted.

Provide paint and coating systems listed below where the Drawings refer to this Specification section or reference any item to be painted or coated, unless a specific paint or coating system is specified elsewhere.

This list is intended to cover all potential conditions that may require painting and not all paint and coating systems listed below may not be included in the Work.

A. Equipment: Exterior Non-Submerged Ferrous Metals (Epoxy, Polyurethane)		
Factory Applied Primer	1. Tnemec: Series 1 Omnithane 2. Corothane I Mio-Zinc Primer 3. PPG: Amercoat 68 HS 4. Or Equal	DFT 2.5 – 3.5 mils DFT 3 – 4 mils DFT 2 – 5 mils
Factory Applied Intermediate Coat	1. Tnemec: Series 66 Hi-Build Epoxoline or Series N69 Hi-Build Epoxoline II 2. S-W: Macropoxy 646 3. PPG: Amercoat 370 4. Or Equal	DFT 3 – 5 mils DFT 3 – 5 mils DFT 4 – 6 mils
Factory Applied Finish Coat	1. Tnemec: Series 1095 Endura-Shield 2. S-W: Hi-Solids Polyurethane 250 3. PPG: Amercoat 450H Shield 4. Or Equal	DFT 2.5 – 5 mils DFT 3 – 5 mils DFT 2 – 5 mils
B. Equipment: Interior Non-Submerged Ferrous Metals (Epoxy)		
Factory Applied Primer	1. Tnemec: Series 1 Omnithane 2. S-W: Corothane I Mio-Zinc Primer 3. PPG: Amercoat 68 HS” 4. Or Equal	DFT 2.5 – 3.5 mils DFT 3 – 4 mils DFT 2 – 5 mils
Factory Applied Intermediate Coat	1. Tnemec: Series 66 Hi-Build Epoxoline or Series N69 Hi-Build Epoxoline II 2. S-W: Macropoxy 646 3. PPG: Amerlock2/400 4. Or Equal	DFT 3 – 5 mils DFT 4 – 5 mils DFT 4 – 8 mils
Factory Applied Finish Coat	1. Tnemec: Series 66 Hi-Build Epoxoline or Series N69 Hi-Build Epoxoline II 2. S-W: Macropoxy 646 3. PPG: Amerlock2/400 4. Or Equal	DFT 3 – 5 mils DFT 4 – 5 mils DFT 4 –8 mils

C. Equipment: Exterior or Interior Submerged Ferrous Metals (Epoxy)		
Factory Applied Primer	1. Tnemec: Series 1 Omnithane 2. S-W: Corothane I Mio-Zinc Primer 3. PPG: Amercoat 68HS 4. Or Equal	DFT 2.5 – 3.5 mils DFT 3 – 4 mils DFT 2 – 5 mils
Factory Applied Intermediate Coat	1. Tnemec: Series 66 Hi-Build Epoxoline or Series N69 Hi-Build Epoxoline II 2. S-W: Dura-Plate 235 3. PPG: Amercoat 370 4. Or Equal	DFT 6 – 8 mils DFT 6 – 8 mils DFT 4 – 6 mils
Factory Applied Finish Coat	1. Tnemec: Series 66 Hi-Build Epoxoline or Series N69 Hi-Build Epoxoline II 2. S-W: Dura-Plate 235 3. PPG: Amercoat 450H Shield 4. Or Equal	DFT 6 – 8 mils DFT 6 – 8 mils DFT 2 –5 mils
D. Hot-Dip Galvanized Field Repair Coating (SSPC Paint 20, Acrylic/Polyurethane)		
Field Applied SSPC Paint Spec 20 (Repair Coat)	1. Tnemec: Series 90-97 Tneme-Zinc 2. S-W: Corothane I Galvapac 1K Zinc Primer 3. PPG: Amercoat 68 HS 4. Or Equal: conforming to SSPC Paint Spec 20	DFT 2.5 – 3.5 mils DFT 2 – 3 mils DFT 2 – 5 mils
Field Applied (2) Finish Coats (color match Hot-dip finish)	1. Tnemec: Series 1029 Enduratone 2. S-W: Sher-Cryl HPA Semi-Gloss 3. PPG: Amercoat 450H 4. Or Equal	DFT 2– 3 mils/ct DFT 3– 4 mils/ct DFT 4– 5 mils/ct
E. Ferrous Metals: Exterior Exposure (Epoxy, Polyurethane)		
Factory Applied Primer	1. Tnemec: Series 66 Hi-Build Epoxoline or Series N69 Hi-Build Epoxoline II 2. S-W: Macropoxy 646 3. PPG: Amercoat 385 4. Or Equal	DFT 2 – 3 mils DFT 5 – 7 mils DFT 4 – 8 mils
Field Applied Two Finish Coats	1. Tnemec: Series 1095 Endura-Shield 2. S-W: Hi-Solids Polyurethane 250 3. PPG: Amercoat 450H 4. Or Equal	DFT 2 – 5 mils/ct DFT 3 – 4 mils/ct DFT 2 – 4 mils/ct

F. Ferrous Metals: Interior Exposure (Epoxy)			
Factory Applied (Shop Primer)	1.	Fabricator's Standard Shop Primer: only permitted if specified (allowed) in other Specification Sections.	DFT 1 mil
Factory Applied Primer (unless noted otherwise)	1. 2. 3. 4.	Tnemec: Series 27 F.C. Typoxy S-W: Recoatable Epoxy Primer PPG: Amerlock 370 Or Equal	DFT 2 – 3 mils DFT 4 – 6 mils DFT 4 – 6 mils
Field Applied Two Finish Coats	1. 2. 3. 4.	Tnemec: Series 66 Hi-Build Epoxoline or Series N69 Hi-Build Epoxoline II S-W: Macropoxy 646 PPG: Amerlock 2 Or Equal	DFT 2 – 3 mils/ct DFT 3 – 5 mils/ct DFT 4 – 8 mils/ct
G. Ductile, Cast Iron, Copper, Aluminum, or PVC: Interior or Exterior (Epoxy/Polyurethane)			
Field Applied Prime Coat	1. 2. 3. 4.	Tnemec: Series 66 Hi-Build Epoxoline or Series N69 Hi-Build Epoxoline II S-W: Macropoxy 646 PPG: Amerlock 2 Or Equal	DFT 2 – 3 mils DFT 3 – 5 mils DFT 4 – 8 mils
Field Applied Intermediate Coat	1. 2. 3. 4.	Tnemec: Series N69 Hi-Build Epoxoline II S-W: Macropoxy 646 PPG: Amerlock 2 Or Equal	DFT 4 – 6 mils DFT 3 – 5 mils DFT 4 – 8 mils
Field Applied Finish Coat	1. 2. 3. 4.	Tnemec: Series 1095 Endura-Shield S-W: Hi-Solids Polyurethane 250 PPG: Amercoat 250H Or Equal	DFT 2 – 5 mils DFT 4 – 5 mil DFT 4 – 6 mils
H. Ductile Iron Pipe Submerged (Epoxy)			
Field Applied Prime Coat	1. 2. 3. 4.	Tnemec: Series 21 Epoxoline S-W: Macropoxy 646 PPG: Amerlock 2 Or Equal	DFT 2 – 3 mils DFT 4 – 6 mils DFT 4 – 8 mils
Field Applied Intermediate Coat	1. 2. 3. 4.	Tnemec: Series 21 Epoxoline S-W: Macropoxy 646 PPG: Amerlock 2/400 Or Equal	DFT 4 – 6 mils DFT 4 – 6 mils DFT 4 – 8 mils
Field Applied Finish Coat	1. 2. 3. 4.	Tnemec: Series 21 Epoxoline S-W: Macropoxy 646 PPG: Amerlock 2/400 Or Equal	DFT 4 – 6 mils DFT 4 – 6 mil DFT 4 – 8 mils

I. Insulated Pipe Interior or Exterior Exposure (Acrylic)		
Field Applied Prime Coat	1. Tnemec: Series 151-1051 Elasto-Grip F.C. 2. S-W: Extreme Bond Primer 3. PPG: Pitt Tech Plus Primer 4. Or Equal	DFT 1 – 1.5 mils DFT 1 – 1.5 mils DFT 2 – 4 mils
Field Applied Intermediate Coat	1. Tnemec: Series 1029 Enduratone 2. S-W: Sher-Cryl HPA 3. PPG: Pitt Tech Plus 90-131 4. Or Equal	DFT 2 – 3 mils DFT 2.5 – 4 mils DFT 2 – 4 mils
Field Applied Finish Coat	1. Tnemec: Series 1029 Enduratone 2. S-W: Sher-Cryl HPA 3. PPG: Pitt Tech Plus 90-131 4. Or Equal	DFT 2 – 3 mils DFT 2.5 – 4 mils DFT 2 – 4 mils
Field Applied Finish Coat	1. Tnemec: Series 280 Tneme-Glaze 2. S-W: Pro Industrial WB Catalyzed Epoxy 3. PPG: HPC High Gloss Epoxy 4. Or Equal	DFT 4 – 8 mils DFT 4 – 8 mils DFT 4 – 8 mils

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SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide labor, tools, equipment, and materials necessary to furnish and install electrical work as specified and in accordance with the Drawings and applicable reference standards listed in Article 1.03.

2. Coordinate with the local Electric Utility and Telco/Internet Service Provider to provide new services as shown on the Drawings.

3. In general, electrical Work shall include but not be limited to the following.

   a. Motor wiring, safety disconnects, and motor starters unless integral with equipment

   b. Power distribution equipment

   c. Power outlets and equipment connections

   d. Wiring devices

   e. Control wiring

   f. Complete grounding system

   g. Active Harmonic Correction Equipment

   h. Standby Power Systems

   i. Service Entrance work

   j. Lighting systems

   k. Tele/Data Communications System

   l. Support material and hardware for raceway and electrical equipment

   m. Branch circuit wiring

n. Underground electrical construction

1) All excavation, backfill, surface restoration, and concrete and rebar work shall be provided by the General Contractor. Manholes, Handholes, conduit, and conduit spacers/supports shall be provided by the Electrical Subcontractor. Manholes and handholes shall be installed by the General Contractor.

o. Installation, termination & labeling of all cable and signal wiring for instrumentation and process control equipment.

p. Building wall, floor and roof penetrations for raceways

q. Start up, acceptance testing test reports and instruction of systems operation to the Owner

r. Sequence Work to ensure power is maintained to the existing pump station during construction. Provide temporary power as required per Section 01 15 20 Maintaining Operations.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. Electrical equipment, materials, installation and workmanship shall comply with all state and local building codes, safety and fire law Regulations at the location of the Work and shall conform the applicable codes and standards of the organizations listed:

a. American National Standards Institute, Inc. (ANSI)

b. Association of Edison Illuminating Companies (AEIC)

c. Institute of Electrical and Electronics Engineers (IEEE C2)

d. Insulated Power Cable Engineers Association (IPCEA)

e. National Electrical Code (NEC)

1) Massachusetts

f. National Electrical Manufacturers Association (NEMA)

g. National Fire Protection Association (NFPA)

h. Occupational Safety Health Act (OSHA)

i. Underwriters' Laboratories (UL)

2. Where the Contract requires the Work or any part of the same, to be above the standards required by applicable Laws, ordinances, rules and Regulations and other statutory provisions pertaining to the Work, such Work shall be performed and completed as specified.

3. Should any changes in the Specifications and Drawings be necessary to conform to the requirements of any of the above mentioned codes or standards, notify the Engineer.

B. Drawings required by Governing Authorities: Prepare any detailed diagrams or Drawings which may be required by the governing authorities.

C. Permits, Certificates, Inspections, Fees and Utility Costs

1. Obtain and make payments for all permits, licenses, and certificates that are required for the associated Work.

2. Obtain certificates of approval from the responsible agencies concerned with the Work.

3. Arrange for timely inspections required for Work under this section.

4. Utility company and municipal back charges shall be the responsibility of the Owner. Cost of electricity shall be borne by the Contractor until Substantial Completion.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

B. Coordinate electrical work with the Work of other trades to prevent interferences and to prevent impedance of construction progress.

C. Coordinate with local utility companies and perform installation of their services in accordance with utility company requirements.

D. Where lighting fixtures and other electrical items are shown in conflict with locations of structural members and mechanical or other equipment, furnish and install all required supports and wiring to clear the encroachment for a complete installation.

E. Any Work installed contrary to or without acceptance by the Engineer shall be subject to change as directed by the Engineer at no additional cost to Owner.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Furnish manufacturer's product data, test reports, and materials certifications as required.

C. Shop Drawings to identify the specific equipment and material being supplied; the quantity being supplied; and all accessories, dimensions, descriptions, mounting and connection details, wiring diagrams, elementary control diagrams, equipment interface diagrams and any other information necessary to determine compliance with the Drawings and Specifications. Fabrication and installation shall be in accordance with the approved Shop Drawings.

D. As-built copies of all Shop Drawings.

E. Submit copies of reports, permits, and easements necessary for installation, use, and operation.

F. Submit copies of reports of tests, inspections, and meter readings as specified.

G. Closeout and maintenance material submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

1.09 SEISMIC DESIGN CRITERIA

A. Delegated Design: Design trapeze conduit hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for conduit and equipment shall withstand the effects of gravity, seismic and wind loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple conduits, cable tray, etc. capable of supporting combined weight of supported systems and system contents.

2. Design equipment and supports capable of supporting combined operating weight and loading of supported equipment and connected systems and components, in accordance with the gravity, seismic and wind load combinations given in ASCE 7, and the Structural Design Criteria for the project as provided on the structural drawings.

1.10 WARRANTY

A. Special Warranty/Extended Correction Period

B. Compile and assemble the warranties specified in Division 26 into a separate set of vinyl covered three ring binders, tabulated and indexed for easy reference.

C. Provide complete warranty information for each item. Information to include:

1. Product or equipment list

2. Date of beginning of warranty or bond

3. Duration of warranty or bond

4. Names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services

1.11 DRAWINGS

A. The Specifications supplement the Drawings and provide information pertaining to the methods and materials to be used in the execution of the Work. When a discrepancy occurs contact the Engineer to resolve.

B. All electrical equipment such as junction and pull boxes, panelboards, switches, controls and such other apparatus as may require maintenance and operation from time to time shall be made easily accessible and properly labeled.

C. The Contractor shall examine existing documentation and verify and properly coordinate the placement of outlets. Contractor shall also check all Drawings including mechanical Drawings and Shop Drawings for apparatus for which he must rough-in and to which he must connect.

1.12 RECORD DRAWINGS

A. Maintain a complete and separate set of prints of Drawings and Specifications at job Site for duration of the Project. Record Work completed and all changes from original Contract. Drawings shall clearly and accurately include Work installed as a modification or as an addition to the original design.

B. At completion of Work and prior to final request for payment, submit a complete set of reproducible Record Drawings showing all systems as actually installed.

1.13 JOB CONDITIONS

A. Existing Conditions

1. Existing Utilities: Locate existing underground utilities in excavation areas. If utilities are indicated to remain, support and protect services during excavation operations.

2. Prior to all Work of this section, carefully inspect the installed Work of all other trades and verify that all such Work is complete to the point where this installation may properly commence.

3. Verify that the electrical installation may be made in complete accordance with all pertinent codes and Regulations and the original design.

B. Coordination:

1. Coordinate the installation of electrical items with the schedules for Work of other trades to prevent unnecessary delays in the total Work.

2. Coordinate with all local utility companies and make all installations for their services in accordance with all utility company requirements.

3. Any changes shall be done at the Contractor's expense.

4. Where lighting fixtures and other electrical items are shown in conflict with locations of structural members and mechanical or other equipment, furnish and install all required supports and wiring to clear the encroachment for a complete installation.

5. Any Work installed contrary to or without acceptance by the Engineer shall be subject to change as directed by the Engineer, and no extra compensation will be allowed to the Contractor for making these changes.

C. Accuracy of Data:

1. The Drawings are diagrammatic and functional only, and are not intended to show exact circuit layouts, number of fittings, components and place in satisfactory operational power, lighting, and other electrical systems shown. Install additional circuits, components and material wherever needed to conform to the specific requirements of the equipment whether or not indicated or specified.

2. Information and components called for in the Specification but not shown on Plans or vice versa shall apply and shall be provided as though required expressly by both.

3. The locations of equipment, fixtures, outlets and similar devices shown on the Drawings are approximate only. Field measurements shall take precedence over scaled dimensions from Drawings. Exact locations shall be as accepted by Engineer during construction. Obtain in the field all information relevant to the placing of electrical work and, in case of any interference with other Work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the Work in an acceptable manner.

4. The Drawings and the Specifications are intended to comply with all pertinent codes, Regulations and standards. In the event of discrepancy, the Contractor shall immediately notify the Engineer in writing of said discrepancies and apply for an interpretation and, unless an interpretation is offered in writing by the Engineer prior to the execution of the Contract, the applicable rules and Regulations shall be complied with as a part of the Contract.

5. In case of difference between building codes, Specifications, state Laws, industry standards and the Contract Documents, the most stringent shall govern. Should the Contractor perform any Work that does not comply with the requirements of the applicable building codes, state Laws, and industry standards, he shall bear all cost arising in correcting these deficiencies.

6. Verify size and ratings of motors and other electrically operated devices supplied by others.

7. Check with Engineer before installation of Work for outlets not specified as to location or for Work that interferes with other trades.

1.14 FLASHING, CUTTING, FIREPROOFING AND WATERPROOFING

A. Flashing around all electrical items penetrating roof or exterior walls shall be the responsibility of the Electrical Subcontractor.

B. All cutting of surfaces, including core drilling of walls and slabs, shall be done by the Electrical Subcontractor.

C. Patching shall be done by the Electrical Subcontractor.

D. The Electrical Subcontractor shall fireproof, waterproof and seal all openings in slabs and walls.

1.15 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Use all means necessary to protect electrical system materials before, during and after installation and to protect the installed Work and materials of all other trades.

B. In the event of damage, immediately make all repairs and replacements necessary to the acceptance of the Engineer and at no additional cost to the Owner. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such special tests as directed by the Engineer, at the cost and expense of the Contractor, or shall be replaced by the Contractor at his own expense.

C. Protect the Work of other trades. Restore any damage caused to other trades to the condition existing prior to damage at no additional cost to the Owner.

D. Investigate each space in the building through which equipment must pass to reach its final location. If necessary, the manufacture shall be required to ship his material in sections sized to permit passing through such restricted areas in the building.

1.16 WORK PERFORMANCE

A. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished in this manner for the required Work, the following requirements are mandatory:

1. Electricians must use full protective equipment (i.e., certified and tested insulating material to cover exposed energized electrical components, certified and tested insulated tools, etc.) while working on energized systems in accordance with NFPA 70E.

2. Electricians must wear personal protective equipment while working on energized systems in accordance with NFPA 70E.

3. Before initiating any Work, a job specific Work plan must be developed by the Contractor and the Owner. The Work plan must include procedures to be used on and near the live electrical equipment, barriers to be installed, and safety equipment to be used and exit pathways.

4. Work on energized circuits or equipment cannot begin until prior written approval is obtained from the Owner.

1.17 DEFINITIONS

A. As used in this Specification, “provide” means “furnish and install”, “furnish” means “to purchase and deliver to the Project Site complete with every necessary appurtenance and support and to store in a secure area in accordance with manufacturer’s instructions”, and “install” means “to unload at the delivery point at the Site or retrieve from storage, move to point of installation and perform every operation necessary to establish secure mounting and correct operation at the proper location in the Project”.

B. Finished Areas: In general, areas with carpet or tile floors, lay-in or fixed ceiling tile, special architectural ceiling treatment, or tiled, plastered, or paneled walls shall be considered finished areas.

C. Interior: For the purposes of this Specification, interior is any area within the boundaries of the foundation of any building within the superstructure or other structures not classified as a building.

1.18 TEMPORARY POWER

A. The Contractor shall furnish, install, maintain, and remove the temporary electrical power and lighting systems, including lamps, and pay for all labor, materials, and equipment required therefor. All such temporary electrical work shall meet the requirements of the National Electrical Code, the local utility company, and OSHA.

B. The Contractor shall make all necessary arrangements with the local utility company as to where the temporary electric service can be obtained.

C. The Contractor shall secure and pay for all required permits and back charges for Work performed by others, and other expenses incidental to the installation of the temporary electric service.

1.19 POSTED OPERATING INSTRUCTIONS:

A. Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

1. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

2. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

3. Safety precautions.

4. The procedure in the event of equipment failure.

5. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

B. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.20 MANUFACTURER'S NAMEPLATE

A. Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.21 FIELD FABRICATED NAMEPLATES

A. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the Drawings. Each nameplate inscription shall identify the name of the equipment, function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, black with white letters. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style. All electrical equipment shall be labeled with the following:

1. Panel Name
2. Fed from "Panel Name" & "CKT #"
3. Amps
4. Volts
5. Phase

1.22 ARC FLASH LABEL

A. Provide arc flash labels for all electrical equipment with operating voltages greater than 50 volt per NEC 110.16.

1.23 WARNING SIGNS

A. Exterior warning and caution signs shall be weather resistant, nonfading, preprinted cellulose acetate butyrate signs with 20-gauge, galvanized steel backing, with colors, legend, and size appropriate to the location.

B. Interior warning and caution signs shall be aluminum signs with preprinted baked enamel finish and punched for fasteners. Colors, legend, and size appropriate to location.

1.24 WIRE AND CABLE MARKERS

A. Underground line marking tape shall be permanent, bright colored, continuous printed, metal backed, plastic tape compounded for direct burial service not less than 6 inches wide. Printed legend indicative of general type of underground line below.

B. Wire labels for wires smaller than No. 4. shall be vinyl or vinyl cloth, self-adhesive, wraparound, wire markers with preprinted numbers and letters. Wire sizes No. 4 and larger and multi conductor cables shall be marked with one-piece, nylon locking marker ties equal to Panduit PLM Series.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Materials and equipment shall be listed by UL unless it can be demonstrated that no UL standards exist for a specific item or class of equipment.

B. All other materials, not specifically described but required for a complete and operable electrical installation, shall be new, first quality of their respective kinds, Specification grade or better, and as selected by the Contractor subject to the acceptance by the Engineer.

C. All materials and equipment furnished and installed on this Project shall meet the most stringent efficiency standards of the local utility to qualify for the maximum rebate.

2.02 MATERIAL AND CONSTRUCTION REQUIREMENTS

A. Unless otherwise shown or specified, all enclosures, motors, wiring and other materials and all construction methods shall conform to specification 26 05 33 Raceways and Boxes for Electrical Systems MGS2.

2.03 INTERCHANGEABILITY

A. In all design and purchasing, interchangeability of items of equipment, subassemblies, parts, motors, starters, relays and other items is essential. All similar items shall be of the same manufacturer, type, model and dimensions.

B. For ease of maintenance and parts replacement, to the maximum extent possible, use equipment of a single manufacturer.

C. The Engineer reserves the right to reject any submittal which contains equipment from various manufacturers if suitable materials can be secured from fewer manufacturers and to require that source of materials be unified to the maximum extent possible.

2.04 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 COORDINATION

A. Prior to all Work of this section, carefully inspect the installed Work of all other trades and verify that all such Work is complete to the point where this installation may properly commence.

B. Field verify all locations and dimensions to ensure that the equipment will be properly located, readily accessible, and installed in accordance with all pertinent codes and Regulations, the Contract Documents, and the referenced standards.

C. The Work shall be carefully laid out in advance, and where cutting, drilling, etc., of floors, walls, ceilings, or other surfaces is necessary for the proper installation, this Work shall be carefully done, and any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved at no additional cost to the Owner.

D. In the event any discrepancies are discovered, immediately notify the Engineer in writing. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.02 INSTALLATION

A. Install all equipment and fixtures in complete accordance with the manufacturer's recommendations and all pertinent codes and Regulations.

B. Thoroughly inspect all items of equipment and any items dented, scratched, or otherwise damaged in any manner shall be replaced or repaired and painted to match original finish. All items so repaired and refinished shall be brought to the attention of the Engineer for inspection and acceptance.

C. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete or supported from or on other structural components, as they are constructed.

D. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building and equipment which must be placed in service before further construction can take place.

E. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.

F. The final routing of raceways shall be determined by structural conditions, interferences with other trades and by terminal locations on apparatus. The Engineer reserves the right of a reasonable amount of shifting at no extra cost up until time of roughing in the Work.

G. Where circuits are shown as "home-runs" all necessary fittings and boxes shall be provided for a complete raceway installation.

H. In general, wiring and raceway systems for security alarm, fire alarm, telephone and intercommunications systems are not indicated on the Drawings but shall be furnished and installed under this section.

I. Each lighting and each receptacle circuit shall have its own neutral, dedicated to that circuit. A common neutral for more than one signal phase circuit is not allowed.

J. Surface mounted panel boxed, junction boxes, conduits, etc., shall be supported by spacers to provide a clearance between wall and equipment.

K. Upon completion of all installation, lamping, and testing, thoroughly inspect all exposed portions of the electrical installation and completely remove all exposed labels, soils, markings and foreign material.

3.03 MARKING AND LABELING

A. All panelboards, indoor transformers, cabinets, control panels and other specified equipment shall be labeled with engraved laminated plastic plates with engraved letters. Punch tapes with mastic backings are not acceptable.

B. All starters, disconnect switches and other specified equipment shall be marked with engraved laminated plastic plates and engraved letters. Where individual switches are circuit breakers in power or distribution panel boards do not have cardholders, they shall be marked with ½" high labels.

C. All empty conduits shall have labels tied to the pull string at each end of each empty conduit, marked as to identification of each end. Junction boxes with circuits provided for future use shall be labeled with appropriate circuit designation.

D. All panelboards directories shall be filled out with typewritten identification of each circuit.

3.04 WIRE AND CABLE MARKERS

A. Tag control circuit conductors at both ends and at junction box splices using wire and cable markers with identification numbers as designated on equipment wiring diagrams. Provide typed listing to identify conductors by number and use.

B. Identify spare conductors, individually, at both ends and at junction box splices with number between 1 and 999. Do not duplicate numbers.

C. Identify wire numbers on terminal block marking strips.

D. Provide permanent plastic name tag indicating load for each feeder for all junction boxes, handholes and manholes. Label all process motor wires to yard equipment in handholes and manholes.

3.05 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

B. Provide the services of an independent Testing Agency to perform the specified tests outlined in their respective specification sections.

C. Provide the services of a recognized independent testing agency to perform Commissioning of Electrical Systems as specified in Section 26 08 00 – Commissioning of Electrical Systems.

D. Provide necessary material, equipment, labor and technical supervision to perform and complete the Electrical Acceptance Tests as required.

E. Acceptance tests as specified are defined as those tests and inspections required to determine that the equipment involved is acceptable as delivered to the job Site, that the equipment may be energized for final operational tests and is in accordance with the Specifications.

F. Final acceptance of the equipment and/or workmanship will depend upon performance characteristics as determined by the subject tests, in addition to complete operation tests, on all electrical equipment to show that it will perform the functions for which it was designed.

G. If the test and inspection data submitted should indicate deficiencies in the operation of the electrical apparatus or in the manufacturer thereof, the Contractor shall promptly implement the necessary adjustments, corrections, modifications and/or replacements necessary to be made to meet the specified requirements.

H. Upon completion of the remedial Work, the Testing Agency shall repeat all of the tests on components previously found deficient on the first test or any additional test if they be required. It shall be the responsibility and obligation of the Contractor to have all remedial Work accomplished as may be required by second and/or additional tests.

3.06 CLEANING

A. When Work is complete and has been tested and accepted by Owner, clean all light fixtures, equipment, and exposed surfaces that have been directly affected by this Work. Keep the premises in a neat and orderly condition and at the completion of the Work properly clean up and remove any excess materials from Site.

3.07 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide low-voltage electrical power conductors and cables in accordance with this Section and applicable reference standards listed in Article 1.03.

2. This section includes wires, cables, and connectors for power, lighting, signal, control, and related systems rated 600 volts and less.

B. Related Requirements

1. Section 26 05 00 – Common Work Results for Electrical

2. Section 26 05 23 – Control-Voltage Electrical Power Cables

3. Section 26 05 26 – Grounding and Bonding for Electrical Systems

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. National Fire Protection Association (NFPA)

a. NFPA 70 National Electrical Code

2. Underwriters Laboratories (UL)

a. UL 44 Standard for Thermoset-Insulated Wire and Cable

b. UL 83 Thermoplastic Insulated Wires and Cables

c. UL 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors

d. UL 854 Service Entrance Cable

3. National Electrical Manufacturers Association (NEMA)

   a. WC 70-21 Construction Requirements

4. Institute of Electrical and Electronic Engineers (IEEE)

   a. Standard 82-2002 Test Procedure for Impulse Voltage Tests on Insulated Conductors

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product data

1. Product data for electrical wires, cables, and connectors

2. Product data for Megger insulation testing instrument

3. Report sheets for Megger testing

C. Manufacturer Reports

1. Furnish manufacturer's product data, test reports, and materials certifications as required

D. Closeout and maintenance material submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Deliver wire and cable properly packaged in factory fabricated type containers, or wound on NEMA specified type wire and cable reels.

C. Store wire and cable in clean dry space in original containers. Protect products from weather, damaging fumes, construction debris, and traffic.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. American Insulated Wire Corp.

B. General Cable.

C. The Okonite Co.

D. Southwire Company

E. Or equal

2.02 MATERIALS

A. General

1. Provide factory-fabricated wires of sizes, ampacity ratings, and materials for applications and services indicated. Where not indicated, provide proper wire selection as determined by Installer to comply with Project's installation requirements, NEC and NEMA standards.

2. Provide color-coding for phase identification as specified.

3. Provide factory applied nylon or polyvinyl chloride (PVC) external jackets on wires and cables for pulls in raceways over 100 feet in length, for pulls in raceways with more than three equivalent 90 degree bends, for pulls in conduits underground or under slabs on grade, and where indicated.

B. Service & Distribution Wiring

1. 98 percent conductivity copper

2. Insulation Voltage Rating: 600 volts

3. Insulation: Type XHHW-2, rated 90 degrees C.

4. Use XHHW for #4 and larger and THHN/THWN or XHHW for #6 and smaller.

C. Building Wiring

1. 98 percent conductivity copper

2. Insulation Voltage Rating: 600 volts

3. Insulation: Type THWN/THHN, rated 90 degrees C

4. Stranded conductor: 14 AWG and larger

5. Minimum branch circuit: 12 AWG

6. Minimum 10 AWG for 120-volt circuits more than 100 feet long

7. Minimum 10 AWG for 277-volt circuits more than 230 feet long

D. Control Wiring

1. Control wiring for digital/discrete signal wiring, shall be 600V, minimum 14 AWG, THHN/THWN, rated 90 degrees C, copper stranded, unless specifically indicated otherwise.

2. Instrument cable for analog signal wiring (4-20mA DC) shall be shielded, 2-conductor, 300 volt rated, minimum 18 AWG, Belden No. 8760, Alpha Wire, or approved equal. Provide 600 volt rated cable where cable occupies the same enclosure and/or raceway with voltages greater than 300 volt as specified below

3. Single Shielded Pair Instrument Cable

   a. Tinned copper, XLPE insulated stranded conductors, 18 AWG minimum, twisted pair with overall shield, stranded tinned 18 AWG copper drain wire and overall PVC jacket. Rated for 600 volts minimum and conforming to UL 1581. Cables shall be rated for tray cable (TC) use where installed within a cable tray.

4. Multi-paired Shielded Pair Instrument Cable

   a. Tinned copper, XLPE insulated stranded conductors, No. 16 AWG minimum, twisted pairs with shield over each pair, stranded tinned No. 18 AWG copper drain wire, and overall PVC outer jacket. Rated for 600 volts minimum and conforming to UL 1581 or UL 13. Cables shall be rated for tray cable “TC” use where installed within a cable tray.

E. Variable Frequency Drive (VFD) Cable

1. VFD load-side power cable shall be shielded type specifically listed for use with variable frequency drives.

2. VFD cable shall be UL listed with 600V black XLPE insulation.

3. Cables: stranded type with number and sizes of conductors indicated on Drawings.

4. VFD cable for cable sizes #2 and smaller: provided with 3 stranded tinned-copper circuit conductors, 1 full-sized insulated ground, overall duofoil shield plus 85 percent tinned-copper braid and full-sized tinned copper drain wire.

5. Provide cables sizes larger than #2 with 3 stranded circuit conductors, 3 symmetrical bare copper grounds and 2, 100 percent spiral copper tape shields.

6. Acceptable level of quality for cable: equivalent to Belden Series 295XX.

F. Splices

1. No. 10 and smaller with 600-volt pressure type insulated connector of wire-nut type, or equal; soldered and crimped type not allowed. Wire nut: Buchanan type B-Cap and Minnesota Mining (3M) type Scotchlok.

2. No. 8 and larger with solderless lugs or solderless connectors of lock-tite or similar type properly taped with plastic insulating tape, Minnesota Mining Co. #33, or equal, then two half-lap servings of friction tape, Manson, or equal.

3. Wire connector systems for use with underground conductors shall be UL listed specifically for such use

4. Install service entrance conductors without splices. Electrical equipment feeders shall be spliced only where shown or specifically approved. Control and metering conductors shall be installed without splices.

5. All splices shall be made only by specific permission of the Engineer and then only in manholes or pull boxes and shall be sealed watertight with a heat-shrunk insulation.

6. Tighten electrical connectors and terminals in accordance with manufacturer's published torque tightening values. Where manufacture's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and 486B.

7. Use UL listed splice for underground wires, ducts buried, in conduit and in ducts. Connectors and splices shall be waterproof.

2.03 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 WIRE AND CABLE INSTALLATION

A. Install wire and cables in conduit of size and type indicated on Drawings and Specifications.

B. Install electrical cables, wires, and connectors in compliance with NEC.

C. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL listed pulling compound or lubricant, where necessary.

D. Use pulling means including, fish tape, cable, rope, and basket weave wire/cable grips, which will not damage cables or raceways. Do not use rope hitches for pulling attachment to wire or cable.

E. Conceal cable in finished spaces.

F. Install exposed cable parallel and perpendicular to surfaces or exposed structural members, and follow surface contours, where possible.

G. Size conductors so voltage drop does not exceed 3 percent for branch circuits or 5 percent for feeder/branch circuit combination.

H. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than 10 AWG cabled in individual circuits. Make terminations so there is no bare conductor at the terminal.

I. Provide color coded feeder and branch circuit wiring at termination and splice locations. System neutrals: designated in addition to phase conductors. Equipment grounds shall be green.

J. The number of conductors shown on Drawings is not necessarily the correct number required. As many conductors as are required in each case shall be installed. In general, grounding conductors are not scheduled.

K. In general, wiring for the following systems shall be installed in separate conduits. Do not mix categories in a single raceway.

1. 120 volt power wiring

2. 120 volt control wiring, including, digital input and output signals

3. 24 volt DC control wiring, including, digital input and output signals

4. 24 volt DC analog control wiring (4-20mA)

5. Communications wiring

6. Special & Emergency Systems

L. Conductors 600 volts and below shall be color coded in accordance with the following:

CONDUCTOR	120 / 208 COLOR	480 / 277 COLOR
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	White / Gray
Equipment Grounds	Green	Green

3.02 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

B. Inspect wire and cable for physical damage and proper operation.

C. Measure tightness of bolted connections and compare to torque measurements with manufactures recommended values.

D. Test each electrical circuit after permanent cables are in place with terminators installed, but before cable or wire is connected to equipment or devices to demonstrate that each circuit is free from improper grounds and short circuits.

E. For conductors larger than #8 AWG, perform Insulation-Resistance Test on each field installed conductor with respect to ground and adjacent conductors.

1. Megger Testing to be witnessed by Engineer. Notify Engineer at least 48 hours in advance of testing.

2. Measure insulation resistance with a digital Megger insulation testing instrument in accordance with manufacturer's recommendations. Test instruments are to be provided by the Contractor.

a. Applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable.

b. Take readings for 1 minute and until the reading is constant for 15 seconds.

3. If any insulation resistance measures less than 50 megohms, the cable shall be considered faulty with cable failing the insulation test. In moist environments, bag the ends of the cable to prevent a faulty Megger test.

4. Replace cable which fails insulation tests or fails when tested under full load conditions with new cable for the full length and retest.

5. The below grade service or feeder splice shall be water immersion Megger tested in the presence of the Engineer. Each splice shall be immersed in a grounded water immersion bath for 24 continuous hours prior to and during the test. Criteria for failure shall be as described for cable above.

3.03 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.04 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 26 05 23

CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide control voltage electrical power cables in accordance with this Section and applicable reference standards listed in Article 1.03.

B. Related Requirements

1. Section 26 05 00 – Common Work Results for Electrical.

2. Section 26 05 26 – Grounding and Bonding for Electrical Systems.

3. Section 26 05 33 – Raceways and Boxes for Electrical Systems.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. National Electrical Code (NEC)

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Shop Drawings: submit for approval manufacturer's technical information for shielded instrumentation cable proposed for use.

C. Closeout and maintenance material submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

A. Instrumentation Cable

1. Okonite Company
2. Belden Company
3. Dekoron Wire and Cable Company
4. Or equal

B. Cable Terminations

1. T&B Sta-Kon
2. Burndy Insulug
3. Or equal

2.02 MATERIALS

A. Single shielded pair instrument cable: tinned copper, stranded conductors, 18 AWG minimum with polyethylene insulation, twisted with aluminum-polyester shield, stranded tinned 20 AWG copper drain wire. Rated for 300 volts minimum. Provide 600 volt rated cable where cable occupies the same enclosure and/or raceway with voltages greater than 300 volt as specified below.

B. Multi-paired shielded instrument cable: tinned copper, 7 strand XLPE insulated conductors, 18 AWG minimum, twisted in pairs with aluminum Mylar shield over each pair, silicone rubber fiberglass fire barrier tape, tinned copper drain wire, aluminum Mylar overall shield, Hypalon outer jacket. Provide 600 volt rated cable where cable occupies the same enclosure and/or raceway with voltages greater than 300 volt as specified below.

C. Multi-conductor shielded instrument cable: tinned copper, stranded conductors, 18 AWG minimum, with overall aluminum-polyester shield with 85 percent tinned copper braid shield. Provide 600 volt rated cable where cable occupies the same enclosure and/or raceway with voltages greater than 300 volt as specified below.

D. Shielded Instrument Cable (600V)

1. Tinned copper, XLPE insulated stranded conductors, 18 AWG minimum, twisted pair with overall shield, stranded tinned 18 AWG copper drain wire and overall PVC jacket. Rated for 600 volts minimum and conforming to UL 1581. Cables shall be rated for tray cable (TC) use where installed within a cable tray.

E. Communications cable: 4-pair UTP Category 6 enhanced cable as specified in 27 00 00, Communications.

F. Cable terminals: fork type copper compression terminals with nylon insulation for termination of cable at terminal blocks.

2.03 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install in conformance with the NEC. Install all cable complete with proper terminations at both ends.

B. Install in conduit separate from power cables unless otherwise noted. Install shielded instrumentation and communications cable in ferrous metal, steel conduit throughout the entire run of conduit from end to end.

C. Ground shield on shielded cables at one end only and as recommended by instrument manufacturer.

D. Install and terminate vendor furnished cable in accordance with vendor equipment requirements and cable manufacturer's specific recommendations.

3.02 TESTING

A. Test shielded instrumentation cable shields with an ohmmeter for continuity along the full length of the cable and for shield continuity to ground.

B. Connect shielded instrumentation cables to a calibrated 3 20-milliamp DC signal transmitter and receiver. Test at 4, 12, and 20 milliamp transmitter settings.

3.03 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.04 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.05 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

A. Provide grounding and bonding for electrical systems in accordance with this Section and applicable reference standards listed in Article 1.03.

B. Related Requirements

1. Section 26 05 00 – Common Work Results for Electrical
2. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables
3. Section 26 05 33 – Raceways and Boxes for Electrical Systems
4. Section 26 05 43 – Underground Ducts and Raceways for Electrical Systems
5. Section 26 24 16 – Panelboards

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Institute of Electrical and Electronic Engineers (IEEE)

1. IEEE 81 Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounded System (Part 1)
2. IEEE 141 Recommended Practice for Electric Power Distribution for Industrial Plants
3. IEEE 142 Recommended Practice for Grounding of Industrial and Commercial Power Systems

B. National Electrical Code (NEC) Article 250.

C. Underwriters Laboratories (UL)

1. UL 467 Electrical Grounding and Bonding Equipment

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product data for grounding equipment and appurtenances.

C. Closeout and maintenance material submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 GENERAL

A. Provide each electrical grounding system with assembly of materials required for complete installation including wires/cables, connectors, lugs, clamps, ground rods, bonding jumpers and accessories.

B. Provide electrical grounding conductors for grounding connections matched to power supply wiring materials and sized according to NEC.

C. Provide electrical connectors, lugs, clamps, boding jumpers and accessories as recommended by the respective manufacturer for the particular application, unless other indicated.

D. Ground rods: solid copper clad, 3/4-inch diameter by 10 feet long.

E. Insulated conductors: green in color.

F. Ground bus: bare annealed copper bars of rectangular cross section, ¼-inch x 3-inch x length as required, with 98 percent conductivity, rigidly attached to structure.

G. Bonding strap conductor/connectors: soft copper, 0.05 inch thick and 2-inches wide, except as indicated.

H. Pressure connectors: high conductivity plated units.

I. Bolted clamps: heavy-duty units listed for application.

J. Exothermic welded connections: provided in kit form and selected for specific types, sizes, and combinations of conductors and other items to be connected.]

2.02 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 GROUNDING & BONDING

A. Ground main service entrance ground bus or lug to neutral of incoming service, to enclosure, to building steel, to ground rods/grounding ring, to rebar in concrete footing, and to main cold water pipe. Install grounding bushings or service conduits. Use exothermic style ground connections to the ground rods and building steel.

B. Use of conduit system for ground conductor is not allowed.

C. Provide and install 600 volt insulated bonding conductors throughout the distribution system with connection to bonding (or grounding) terminal on each panel and panel board with connections to other equipment where specifically indicated and noted.

D. Bonding conductors to be continuous where possible. Where splices are required, provide compression connectors of approved pattern. Insulate connectors to equivalent thickness of conductors.

E. Provide grounding system for grounded circuit conductors of dry type transformer secondaries in accordance with NEC. Use exothermic style ground connections to building steel. Enclose grounding conductors in schedule 40 PVC conduit.

F. Provide equipment grounding conductors in all conduits containing power, control, or instrumentation conductors on the load side of the service equipment or on the load side of a separately derived system.

G. Comply with NEC Article 250 for sizes and quantities of equipment grounding conductors, except larger sizes specified. Use of metallic conduit systems for equipment grounding as recognized by the NEC are not permitted.

H. Install grounding bushings on conduits at both primary and secondary entrances to transformers. Ground transformer enclosures to bushings.

I. Install bonding jumper for flexible metal conduit unless fittings are approved for grounding or otherwise comply with NEC.

1. Size jumper to match over-current device

2. Green insulation

3. Connect to grounding bushing at each end

J. Ensure entire electrical system is electrically continuous and permanently and effectively grounded, including electrical equipment and motors.

K. Locate ground rods with a minimum of two rod length from each other and at least the same distance from any other grounding electrode. Connect ground conductors to ground rods by means of exothermic welds except at test wells and as otherwise indicated. Drive rods until tops are 24 inches below finished floor or final grade except as otherwise indicated.

L. Route grounding electrode conductors along the shortest and straightest paths possible without obstructing access or placing conductors where they may be subjected to strain, impact, or damage, except as indicated.

M. Ensure that grounding electrode conductor connections to interior piping, structural members, and the like are accessible for periodic inspection during the life of the structure.

3.02 BONDING FOR OTHER TRADES

A. Signal raceways, water piping, heating piping and metallic air ducts shall be bonded together and to the grounding conductor with No. 8 soft drawn bare solid conductors. Connections to pipes shall be made with cast clamps of like material as the pipes to which attached, to ducting terminated in a secure manner by best practical means, bonding across any flexible or insulated connections.

B. All bonding conductors shall be installed in a neat manner properly shaped for contour of surface involved and properly supported. At locations remote from the main service entrance panel boards, bond to the largest raceway nearby.

3.03 FIELD TESTING

A. Perform point-to-point tests to determine resistance between the main grounding system and all major electrical frames, system neutral, and derived neutral points. Perform tests using clamp-on digital ground resistance tester with 2% accuracy or better.

B. Perform ground fault protection system functional testing for distribution equipment having ground fault protection.

C. Perform ground continuity and functional tests:

1. From main switchgear to grounding electrode and/or cold water main.

2. Between each main secondary feeder switchboard ground and its termination point (distribution panels, panelboards, motor control centers, UPS systems, electric heater disconnects, chiller starters, and other such equipment) and all feeders shown on single-line diagram.

3. Between each distribution panel to panelboards and between each panelboard to panelboard (excluding branch circuits).

4. Test each branch circuit receptacle for proper polarity and ground using a plug-in test device.

A. Provide the services of an independent testing agency to perform the specified tests for the following systems.

1. Ground system resistance: testing company to perform testing according to National Electrical Testing Association (NETA) standards and procedures. Testing results to be submitted on NETA forms and testing data e certified by the respective agency. Test results shall indicate recommended action for a sub-par test results. Results shall list recommended test values that should be obtained for new installation.

2. Measure ground resistance without the soil being moistened by any means other than natural precipitation or natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by the three-point fall of potential method in accordance with Section 9.03 of IEEE 81. Simple moisture addition is not acceptable.

a. Ground/resistance maximum values shall be as follows.

1) Equipment rated 500 kVA and less: 10 ohms.

2) Equipment rated 500 kVA to 1000 Kva: 5 ohms.

3) Equipment rated over 1000 kVA: 3 ohms.

4) Unfenced substations and pad mounted equipment: 5 ohms.

5) Fence Grounds: 10 ohms.

D. Where ground resistances exceed specified values, and if directed, modify the grounding system to reduce resistance values.

3.04 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.05 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.06 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 26 05 33

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide the labor, tools, equipment, and materials necessary to furnish and install raceways, boxes, and supporting devices in accordance with the Plans and applicable reference standards listed in Article 1.03.

B. Types of products specified in this section include

1. Conduit, Raceways & Fittings

2. Supporting Devices

3. Boxes and Fittings

C. Related Requirements

1. Section 26 05 00 – Common Work Results for Electrical

2. Section 26 05 43 – Underground Ducts and Raceways for Electrical Systems

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. National Electrical Code (NEC)

2. National Electrical Manufacturers Association (NEMA)

3. Underwriters Laboratories (UL)

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Furnish manufacturer's test reports, and material certifications as required.

C. Product data for cabinets and enclosures.

D. Shop Drawings for shop fabricated (non-stock items) floor boxes and boxes, enclosures and cabinets.

E. Closeout and maintenance material submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 CONDUIT, RACEWAYS & FITTINGS

A. Provide conduit with 3/4-inch diameter minimum, except where specifically shown smaller on Drawings.

B. Conduit, connectors, and fittings shall be approved for the installation of electrical conductors.

C. Refer to Table 3.01A for approved conduit installation guidelines.

1. Rigid Galvanized Steel Conduit

a. Rigid steel conduit (RGS), including couplings, elbows, bends, and nipples, shall conform to the requirements of UL 6 and NEMA C80.1 Steel fittings shall be galvanized by the hot-dip process.

b. Fittings for rigid steel conduit shall be threaded and shall conform to NEMA FB 1.

c. Gaskets to be solid for fittings sized 1-1/2 inches and less. Conduit fittings with blank covers to have gaskets except in clean, dry areas or at the lowest point of a conduit run where drainage is required.

d. Covers to have captive screws and be accessible after the Work has been completed.

2. Rigid Aluminum Conduit (RAC)

a. Provide UL 6A and ANSI C80.5 RAC, including couplings, elbows, bends, and nipples.

b. Provide NEMA FB 1 threaded fittings for rigid aluminum conduit. Fittings: galvanized by hot dip process unless manufacturer dictates aluminum for specific application.

c. Gaskets shall be solid for fittings sized 1-1/2 inches and less. Conduit fittings with blank covers shall have gaskets except in clean, dry areas or at the lowest point of a conduit run where drainage is required.

d. Covers to have captive screws and be accessible after Work has been completed.

3. PVC Coated Rigid Metal Conduit

a. Rigid galvanized metal conduit coated with 40 mils thick polyvinylchloride coating.

b. Fittings, elbows, supporting devices and accessories shall include factory applied 20 mils thick polyvinylchloride coating and be manufactured by the same as that of the conduit.

c. Use tools as recommended by the manufacturer so as not to damage PVC coating. Where coating is damaged, touch-up with PVC paint in the field after installation.

4. Rigid Plastic Conduit

a. PVC Schedule 40: Conduit shall be made of polyvinyl chloride compound that shall be homogeneous plastic material free from cracks, holes or foreign inclusions. Conduit shall be rated for use with 90 degree C conductors, UL Listed. Use solvent cement to join conduits as manufactured the same as the conduit manufacturer.

b. PVC Schedule 80: Heavy wall PVC conduit that shall be made of polyvinyl chloride compound that shall be homogeneous plastic material free from cracks, holes or foreign inclusions. Conduit shall be rated for use with 90 degree C conductors, UL Listed. Use solvent cement to join conduits as manufactured the same as the conduit manufacturer.

5. Flexible Metallic Conduit

a. Provide UL1 flexible metallic conduit.

b. Provided liquid tight flexible metallic conduit with a protective jacket of PVC extruded over a flexible interlocked galvanized steel core to protect wiring against moisture, oil, chemicals, and corrosive fumes.

c. Provide UL 514B fittings for flexible metallic conduit, Type I box connector, electrical, Type III coupling, electrical conduit, flexible steel, or Type IV adapter, electrical conduit.

6. Wireways

a. Wireways and auxiliary gutters for use in exposed, dry locations shall be a prefabricated channel-shaped sheet metal trough with hinged or removable covers, associated fittings, and supports for housing, and protecting electrical wires and cables in accordance with UL 870.

b. Straight sections of trough, elbows, tees, crosses, closing plates, connectors, and hanging brackets constructed from sheet steel of commercial quality not less than 16-gage. Clean sheet metal component parts, phosphatize, and coat with a corrosion-resistant gray paint.

c. Straight sections of wireways and auxiliary gutters to be solid or have knockouts as indicated in both sides and bottom, 3 inches on center.

d. Straight sections may not be more than 5-feet long, with covers held closed with screws.

7. Conduit Seals

a. Provide E.Y.S. seal fittings with appropriate potting material where conduits enter or leave a Class 1, Division 1 or 2 environments or a Class 2, Division 1 or 2 environment, and chemical rooms.

b. Provide factory fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit, or tubing passing through concrete floors and walls. Provide a cast in place water stop wall sleeve with a mechanical pipe seal between the conduit and the sleeve. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.

2.02 SUPPORTING DEVICES

A. Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic. Products for use outdoors shall be hot dip galvanized unless material is inherently corrosion resistant.

B. Refer to Table 2.02A for approved supporting device installation guidelines.

1. Conduit Supports

a. Single run hangers: galvanized steel conduit straps or clamps, or cast metal beam clamps. Perforated straps and spring steel clips and clamps will not be permitted.

b. Group run hangers: minimum 12-gauge galvanized performed U-channel rack with conduit fittings; 25 percent spare capacity

c. Hanger rods: threaded steel, 3/8-inch diameter, or as identified on Drawings

d. Vertical run supports: minimum 12-gauge galvanized performed U-channel struts with conduit fittings

2. Equipment and Lighting Supports

a. 12-gauge galvanized performed U-channel struts with fixture and conduit fittings, as applicable, unless indicated otherwise on Drawings.

3. Corrosive Area Supports

a. Clamp hangers, pipe straps, and clamp back spacers for use with PVC-coated rigid metal conduit shall have 40 mil gray PVC exterior coating.

b. Provide nonmetallic PVC material clamp hangers, pipe straps, etc. for use with PVC nonmetallic conduit.

c. Hanger rods: 20 mil gray PVC exterior coated rod with threaded ends only 3/8-inch and 1/2-inch sizes as required.

d. Strut support: 20 mil gray PVC exterior coating strut. Standard channel, slotted channel, and back to back channel are acceptable.

e. Provide stainless steel supports and accessories in lieu of PVC coated supports when indicated in Table 2.02A below.

TABLE 2.02A – Supporting Devices

Location/Equipment	Acceptable Support Type
Exterior	Galvanized Steel U-Channel
Pump Station Wet wells	PVC Coated Strut

2.03 BOXES AND FITTINGS

A. Boxes must have sufficient volume to accommodate the number of conductors entering the box in accordance with NFPA 70 and UL 514A.

B. In general, boxes that are exposed to weather, process areas, normally wet locations, and locations exposed in mechanical spaces shall be cast-metal. Boxes in all other finished areas shall be sheet metal. Boxes installed in corrosive areas, such as the chemical feed room, shall be nonmetallic.

A. Furnish electrical equipment enclosure in a single painted steel, two-sided NEMA 4X public works traffic enclosure with maximum dimensions of 72 inches height, 72 inches length, 36 inches depth. The electrical equipment enclosure shall include:

1. Two doors on both sides of the cabinet to access power and communications equipment.

2. 200 Amp, single pole 120/240-volt Utility disconnect switch.

3. 200 Amp, 120/240-volt, NEMA 1, 30 circuit, 22KAIC panelboard LP.

4. 200 Amp, 120/240-volt, ATS

5. Surge protector/Overcurrent protection.

6. A minimum 400-watt heater to prevent condensation.

7. A ventilation fan and thermostat kit.

8. 20-Amp 120-volt GFCI Service receptacle with in-use cover.

9. C-STRIP-A-LIN4-46L-40K-WH or equal LED lighting fixture controlled by a single pole switch with in-use cover

10. The outer enclosure shall be an aluminum single-sided, double-door NEMA 3R enclosure painted color by architectural engineer.

11. 12-inch high Enclosure Base Kit

12. Vendor supplied Pump Control Panel

B. Cabinet manufacturer: APX or equivalent and sized to house the electrical equipment indicated on the Drawings including electrical panels, contactors, heaters, and all components listed above.

C. Refer to Table 2.03A for approved enclosure types.

1. Sheet Metal Outlet Boxes

a. Sheet Metal Outlet Boxes: Standard type galvanized steel, minimum four inch square or octagon by 1-1/2 inch deep.

b. Luminaire and Equipment Supporting boxes: Rated for weight of equipment supported; include 2 inch male fixture studs where required.

c. Single Wall Type: Minimum size, four inch square by 1-1/2 inch or 2-1/8 inch deep, except as noted. Provide dry wall device covers raised 3/4 inch minimum to insure flush finish mounting.

d. Ganged Wall Type: Minimum depth three inches except as noted, ganged as required under common plate to contain devices shown. On 277-volt circuits, ganged boxes for switches shall contain only one circuit or equip box with permanent barriers per NEC Art 404-8.

2. Cast Outlet Boxes

a. Type FS shallow and type FD deep, cast ferroalloy

b. Provide number of threaded hubs as required.

c. Use in all exterior, damp and locations exposed in mechanical spaces.

d. Provide gasketed cover and accessories by box manufacturer for complete weatherproofing. Provide correct box to accept weatherproof covers as specified.

3. Sheet Metal Pull & Junction Boxes

a. Sheet metal boxes shall be standard type galvanized steel and must conform to UL 50.

b. Box dimensions shall be minimum four inch square or octagon by 2/1/2 inch deep.

c. Sizes up to 12 by 12 by 6 inches: Provide screw-type or hinged covers.

d. Sizes greater than 12 by 12 by 6 inches: Provide hinged covers.

e. Boxes shall be sized to accommodate all incoming raceways.

4. Nonmetallic Outlet, Device, and Wiring Boxes

a. Conform to NEMA OS 2, Nonmetallic Outlet Boxes, Device Boxes, Covers, and box Supports, and UL 514C, Nonmetallic Outlet Boxes, Flush Device Boxes and Covers. Boxes shall be molded polyvinyl chloride (PVC), or fiberglass units of type, shape, size, and depth to suit location and application.

b. Boxes shall be equipped with threaded screw holes for device and cover plate mounting. Each box shall have a molded cover of matching material suitable for the application and location installed.

TABLE 2.03A – Electrical Enclosure Types

Location/Equipment	Acceptable Enclosure Type
Exterior	NEMA 4X
Pump Station Wet wells	NEMA 7 (Explosion Proof) NEMA 4X for Intrinsically Safe Equipment

2.04 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 CONDUIT

A. Uses Permitted

1. Use liquid tight flexible metal conduit for the final 24 inches of connections to motors or control items subject to movement or vibration.

2. Use RGS for all exterior aboveground installations unless otherwise noted.

3. Use PVC coated rigid steel conduit, or as scheduled below, for installation in corrosive areas, and other areas as identified on the Drawings.

4. Exposed raceways in Manufacturing Areas, Utility Rooms, Mechanical Rooms, Warehouse Areas, etc., shall be Rigid Galvanized Steel below 15 feet.

5. Use Schedule 40 PVC conduit for exterior direct buried installations. Use Schedule 40 PVC conduit for exterior concrete encased installations. Use Schedule 80 PVC conduit for underground installations under driveways. The transition from underground and from concrete encasement to riser shall be PVC coated rigid steel conduit to a minimum of 12 inches above finished floor and/or finished grade elevation. All elbows shall be prefabricated Rigid Steel to prevent wire burn through. Reference Section 26 05 43 for further requirements.

6. Install conduit seals for conduit penetrations of slabs on grade and exterior walls below grade and where indicated. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal. Provide seals for interior of conduits penetrating exterior or water bearing walls, consisting of gland type sealing bushings or RTV closed cell silicone foam.

7. Refer to Table 3.01A below for approved conduit types.

TABLE 3.01A – Conduit Types

Location/Equipment	Approved Conduit Type
Exterior	Rigid Galvanized Steel
Underground	Schedule 40 PVC
Pump Station Wet wells	Rigid Aluminum

B. Power, lighting, control, emergency light and power, and special-service systems and all related components shall be installed in accordance with NFPA 70, and shall be enclosed in separate conduit or separate conduit systems as indicated on the Drawings and as specified herein.

C. Any run of conduit between outlet and outlet, between fitting and fitting, or between outlet and fitting shall contain no more than the equivalent of three 90-degree bends, including those bends located immediately at the outlet or fitting. Field bends shall be made in accordance with the manufacturer's recommendations, which normally require use of a one-size-larger bender than would be required for uncoated conduit. Installed conduit and fittings shall be free of dirt and trash and shall not be deformed or crushed. Empty conduit shall have a pull rope stalled.

D. Conduit shall be installed with a minimum of 3 inches of free air space separation from mechanical piping.

E. Conduit in finished areas shall be installed concealed. Conduit passing through masonry or concrete walls shall be installed in sleeves. Conduit shall be securely clamped and supported at least every 10 feet vertically and 8 feet horizontally. Galvanized pipe straps shall be fastened to structure with bolts, screws, and anchors. Wooden masonry plugs shall not be used.

F. Install exposed conduits, parallel or perpendicular to walls, ceilings, or structural members. Do not run through structural members. Avoid horizontal runs within partitions or sidewalls. Avoid ceiling inserts, lights, or ventilation ducts or outlets. Do not run conduits across pipe shafts or ventilation duct openings and keep conduits a minimum of 6 inches from parallel runs of flues, hot water pipes, or other sources of heat. Wherever possible, install horizontal raceway runs above water and steam piping.

G. Do not run conduits exposed on exterior surface of buildings. Seal conduits penetrating exterior walls below grade, at grade floors, or below grade floors to prevent moisture migration. Seal conduit exterior with a mechanical pipe seal. Interior conduit seal shall be a gland type sealing bushing or RTV closed cell silicone foam. Ensure that conduits do not retain water against these seals.

H. Raceways penetrating fire rated walls, floors, and partitions shall be sealed with a fire rated sealant.

I. Support conduits with materials specifically made for this purpose. Do not use wire hangers. Do not attach any parts of the raceway system to ventilation ducts. Conduit supports shall be attached to the building. Support conduits on each side of bends and on a spacing not to exceed the following: 6 feet for conduits smaller than 1 1/4-inches and 8 feet for conduits 1 1/4-inches and larger. Support riser conduits at each floor level with clamp hangers. Securely anchor underground conduits to prevent movement during placement of concrete or backfill. Use precast separators and heavy gauge wire ties or other approved fasteners.

J. Provide E.Y.S. seal fittings with appropriate potting material where conduits enter or leave a Class 1, Division 1 or 2 environments or a Class 2, Division 1 or 2 environment, and chemical rooms.

K. Conduit connections to boxes and fittings shall be supported not more than 36 inches from the connection point. Conduit bends shall be supported not more than 36 inches from each change in direction. Conduit shall be installed in neat symmetrical lines parallel to the centerlines of the building construction and the building outline. Multiple runs shall be parallel and grouped whenever possible on common supports. Exposed ends of conduit without conductors shall be sealed with watertight caps or plugs.

L. Bonding wires shall be used in flexible conduit for all circuits. Flexible conduit shall not be considered a ground conductor.

M. Liquid tight flexible metallic conduits shall be used in wet and oily locations and to complete the connection to motor-driven equipment.

N. Electrical connections to vibration-isolated equipment shall be made with flexible metallic conduit in a manner that will not impair the function of the equipment.

O. A polypropylene pull rope with a tensile strength not less than 130 pounds shall be installed in empty conduit.

P. Electrical conduit may be embedded in concrete according to the provisions of Article 6.3 of ACI 318 Building Code Requirements for Reinforced Concrete, provided the following conditions are met:

1. Outside diameter of conduit shall not exceed 1/3 of concrete thickness. Maximum conduit outside diameter shall not exceed 3 inches when embedded in slab.

2. Conduit shall not be placed closer than three diameters on center. Route conduit to minimize crossing of different conduit runs.

3. Conduit shall not be embedded in structural concrete slabs less than four inches thick.

4. A 1-1/2 inch minimum concrete cover shall be provided for conduits in structural concrete slabs.

Q. Installation of Underground Conduit

1. Minimum of 3/4 inch conduit in or under concrete slab on grade.

2. Where conduits are installed in concrete slabs, on the ground, underground, or exposed to the weather, make all joints liquid tight and gas tight.

3. Bury all underground conduit, except under concrete slabs placed on fill, to a depth of at least 30 inches below finished grade unless otherwise indicated on the Drawings .

4. Slope ducts to drain away from buildings into manholes and/or handholes. Adjust final slopes to coordinate with existing Site utilities.

5. Install on undisturbed soil where possible. Concrete encase conduits as shown on Drawings. Use pit run gravel and sand, placed 8-inch lifts and compacted for backfill.

6. Reference Section 26 05 43 for further requirements.

R. Installation of Rigid Metal Conduit

1. Ends of conduit shall be cut square, reamed and threaded, and joints shall be brought butt-to-butt in the couplings. Joints shall be mechanically tight. Conduit shall be protected against damage and the entrance of water or foreign material during construction.

2. Ninety-degree bends of conduit with a diameter larger than 1 inch shall be made with factory-made elbows. Conduit elbows larger than 2 1/2 inches shall be long radius. Field-made bends and offsets shall be made with an approved hickey or conduit-bending machine. Changes in directions of runs shall be made with symmetrical bends or cast-metal fittings.

3. At connections to sheet metal enclosures and boxes, a sufficient number of threads shall project through to permit the bushing to be drawn tight against the end of the conduit, after which the locknut shall be pulled up sufficiently tight to draw the bushing into firm electrical contact with the box. Conduit shall be fastened to sheet metal boxes and cabinets with two locknuts where required by NFPA 70 where insulating bushings are used, where bushings cannot be brought into firm contact with the box, and where indicated.

4. Conduit joints shall be made with tapered threads set firmly. Each length of conduit cut in the field shall be reamed before installation. Where conduit is threaded in the field, each threaded end shall consist of at least five full threads. Corrosion-inhibitive compound (cold galvanizing paint) shall be used on all conduit threads or any locations where the original hot galvanized surface has been compromised.

5. Conduit stubbed-up through concrete floors for connections to free-standing equipment except motor-control centers, cubicles, and other such items of equipment shall be provided with a minimum of a 12 inch riser above the floor slab is of sufficient thickness; if not, a floor box shall be provided and set flush with the finished floor. Conduits installed for future use shall be terminated with a coupling and plug set flush with the floor.

3.01 SUPPORTING DEVICES

A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.

B. Coordinate with the building structural system and with other electrical installations.

C. Conform to manufacturer's recommendations for selection and installation of supports.

D. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.

E. Support parallel runs of horizontal raceways together on trapeze type hangers.

F. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1 1/2 inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4 inch diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.

G. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.

H. Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.

I. Install sleeves in concrete slabs and walls and all other fire rated floors and walls for raceways and cable installations. For sleeves through fire rated wall or floor construction, apply UL listed fire-stopping sealant in gaps between sleeves and enclosed conduits and cables.

3.02 BOXES AND FITTINGS

A. Pullboxes shall be furnished and installed where necessary in the conduit system to facilitate conductor installation. Conduit runs longer than 100 feet or with more than three right angle bends shall have a pull box installed at a convenient intermediate location.

B. Boxes and enclosures shall be securely mounted to the building structure with supporting facilities independent of the conduit entering or leaving the boxes.

C. Bonding jumpers shall be used around concentric or eccentric knockouts.

D. Installation of Outlet Boxes

1. Use nonmetallic boxes in corrosive areas such as chemical feed area and as designated on the Plans.

2. Use explosion proof boxes in Hazardous areas as identified on the Drawings.

3. Use cast metal boxes in all other locations. Each box with associated covers and fittings shall have a NEMA rating for each location installed.

E. Installation of Pull and Junction Boxes

1. Use general-purpose boxes (NEMA 1) in finished areas with framed construction.

2. Use dust-tight and oil-tight boxes (NEMA 12) in other dry interior areas.

3. Use explosion proof boxes (NEMA 7) in hazardous areas as designated on the Plans.

4. Use watertight boxes (NEMA 4) for exterior and wet locations on outdoor structure where moisture is present.

5. Use corrosion resistant watertight boxes (NEMA 4X) for wet locations and corrosion filled areas, such as the chemical feed area, and as identified on the Drawings.

3.03 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.04 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.05 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 26 05 43

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

A. Provide underground ducts and raceways for electrical systems including necessary excavation, backfill and surface restoration in accordance with this Section and applicable reference standards listed in Article 1.03.

B. Provide underground conduit duct banks with manholes and pullboxes for power, and lighting circuits as shown on Drawings.

C. Related Requirements

1. Section 26 05 00 - Common Work Results for Electrical

2. Section 26 05 33 - Raceways and Boxes for Electrical Systems

3. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables

4. Section 26 05 26 - Grounding and Bonding for Electrical Systems

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. American National Standards Institute (ANSI)

a. ANSI A14.3, Safety Requirements for Fixed Ladders

b. ANSI 77 Specification for Underground Enclosure Integrity

2. ASTM International (ASTM)

a. ASTM A48 Standard Specification for Gray Iron Castings

b. ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

c. ASTM C858 Standard Specification for Underground Precast Concrete Utility Structures

d. ASTM D570 Standard Test Method for Water Absorption of Plastics

1) Section 5, 6.1, 6.5: Water Absorption

e. ASTM D635 Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position

f. ASTM D790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

g. ASTM G154 Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials

3. Institute of Electrical and Electronic Engineers (IEEE)

4. Insulated Cable Engineers Association (ICEA)

5. National Electrical Code (NEC)

6. National Electrical Manufacturers Association (NEMA)

a. TC-2 Conduit

b. TC-3 Fittings

7. National Electrical Safety Code (NESC)

8. Occupational Safety and Health Administration (OSHA)

9. Underwriters Laboratories (UL)

a. UL 651 Standard for Schedule 40, 80, Type EB, and A rigid PVC conduit and fittings.

b. UL 514 Standard for Conduit, Tubing and Cable Fittings

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

B. Coordinate installation with piping and other underground systems and structures and locate clear of interferences. Coordinate manhole and handhole installation with piping, sheet piling and other underground systems and structures and locate clear of interferences.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Shop Drawings

1. Layouts showing the proposed routing of duct banks and the locations of manholes, handholes and areas of reinforcement

2. Manufacturer's technical information for manholes, handholes and accessories

3. Drawings showing interior and exterior manhole and handhole dimensions and details of openings, jointing, inserts, reinforcing, size and locations of openings, and accessory locations

4. Certificate of concrete and steel used in underground pre-cast concrete utility structures, according to ASTM C858

5. Product data for conduit, manhole, handhole, grounding and accessories

6. Product data for iron and steel duct bank reinforcement.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

B. Provide protection of surrounding environment from erosion and sediment from the impacted site.

C. Retain the services of an underground utility investigation company to identify potential underground interferences within the limit of work. Utility investigation shall consist of subsurface utility investigation equipment such as electro-magnetic-locator or ground penetrating radar. Submit results to Engineer prior to commencing with underground work.

D. Provide means for dewatering duct banks in accordance with geotechnical information and reports. No direct offsite dewatering is authorized by specifications or drawings, unless specifically noted. Discharge to any surface water shall require DEP permitting. Use sock filter or pumping methods as appropriate to protect receiving water locations. Coordinate with permit requirements for final dewatering rate.

PART 2 – PRODUCTS

2.01 DUCT BANK CONDUIT

A. Duct: Schedule 40 and Schedule 80 PVC conduit and fittings in accordance with Section 26 05 33.

B. Rigid steel conduit and fittings in accordance with Section 26 05 33.

C. Duct bank conduit spacers: non-metallic, snap together intermediate and bottom pieces, sized for conduit diameter and code spacing. Acceptable level of quality: equivalent to Carlon Snap-Loc or approved equal. Separators shall be compatible with the conduit utilized.

2.02 PRECAST CONCRETE MANHOLES & HANDHOLES

A. Material and Construction

1. Pre-cast reinforced concrete, 5000PSI minimum after 28 days, grade 60 reinforcement.

2. Size and dimensions shall be as indicated on the Drawings or required by the utility companies

3. Duct entrances sized and located to suit duct banks. Duct-bank penetration shall be watertight.

4. Modular sections with tongue-and-groove joints. Joints shall be gasketed and watertight.

5. Nominal inside dimensions as shown

6. Base Section: Shall include sump, grate, and ground rod openings.

7. Sump Covers; ASTM A48; Class 30B galvanized iron.

B. Frames and Covers

1. Material: Cast iron conforming to ASTM A 48, Class 30A

2. Covers: 36-inch minimum diameter, watertight, sealed type, marked "ELECTRICAL", “COMMUNICATIONS” or “CONTROLS” in raised 2-inch letters as applicable.

3. Frame shall be grouted on the manhole.

4. Acceptable Manufacturers

   a. Neenah Foundry Company

   b. EJ Company

   c. Campbell Foundry Company

   d. Or approved equal

C. Pulling Irons

1. Material: galvanized steel

2. Cast in the wall opposite to the centerline of each incoming duct bank and 12 inches below centerline of bottom line of ducts.

3. Acceptable level of quality; equivalent to the following.

   a. Cat. No. 8119 by Hubbell Power Systems

   b. Cat. No. 12A15 by INWESCO

   c. Cat. No. 004-570-C by M.A. Industries

   d. Or approved equal

D. Insulators

1. Material: Porcelain

2. Acceptable level of quality; equivalent to the following.

   a. Cat. No. J 5122 by Joslyn Manufacturing and Supply Company

   b. Cat. No. 2120 by Hubbard and Company

   c. Or approved equal

E. Manhole Steps

1. Material: Extruded aluminum

2. Steps spaced evenly at approximately twelve to sixteen inch centers and shall project evenly from manhole walls

3. Acceptable level of quality; equivalent to the following:

   a. INWESCO

   b. MA Industries

   c. Bass and Hays

   d. Or equal

2.03 CONDUIT SEALING SYSTEMS

A. Provide waterproofing of conduit penetrations and sealing around cables inside conduit/duct systems in accordance with the following.

B. Conduit Sealing Systems

1. Conduit Sleeves

   a. Provide conduit sleeves for new cast-in-place construction to accommodate conduit penetrations through foundation walls.

   b. Conduit sleeves shall be pre-manufactured, PVC watertight sleeves with proprietary cement coating to create a homogeneous bond with poured concrete.

   c. Watertightness rating: 72 psi (5 bar)

   d. Sleeves shall have customizable lengths when ordered or cut to size on site for the specific application.

   e. Provide sleeves with compatible PE endcaps to keep the sleeves clean and debris free during concrete pour.

   f. Acceptable level of quality for conduit sleeves: equivalent to Polywater, PZVR series, or approved equal.

   g. Provide modular, mechanical type, seals at each sleeved conduit penetration as specified below.

2. Mechanical Conduit Seals

   a. Unless otherwise specified or indicated on the Drawings, all core drilled or sleeved foundation wall penetrations shall be provided with a modular, mechanical type, sealing system.

b. The sealing system shall consist of inter-locking synthetic rubber links shaped to continuously fill the annular space between the conduit and the cored opening or sleeve. The elastomeric element shall be sized and selected in accordance with the manufacturer's recommendations and sizing guidelines.

c. Modular seal bolts and nuts shall be 316 stainless steel AISI 316 L and nuts shall be molded into the pressure plate. Pressure plates shall be made of glass fiber reinforced polyamine.

d. Modular seal shall have integrated visual installation indicator to allow the inspector to confirm the seal is properly installed.

e. Modular seal shall be gas-tight, watertight and rodent resistant. Seal shall meet a minimum of 21 psig and up to 72 psig against hydrostatic pressure.

f. Acceptable level of quality for mechanical conduit sleeves: equivalent to Polywater, PGKD series, or approved equal.

3. Duct Sealant

a. The following duct sealant system shall be provided for all underground vaults, manholes and foundation penetrations:

1) Sealant shall be provided to prevent ingress of water or gas into the conduit/duct systems. Sealant shall be provided at both ends of the conduit run.

2) Shall be 2-part, 98% closed-cell urethane foam that reacts to set in 5-10 minutes at 70F.

3) Shall be capable of sealing up to 12” conduits with multiple cable configurations.

4) Shall be re-enterable and capable of withstanding temperatures from -20F to 200F; and be chemically resistant to gasoline, oils, dilute acids and bases.

5) Shall not affect the physical properties of wire or cable.

6) Shall have 145-lb compressive strength.

7) Shall be capable of holding 22ft of water head pressure continuous or 90ft of water head pressure short-term. It shall block up to 5 psi of vapor and gas continuous.

8) Selant shall meet UL 94 with a fire rating of HBF. It shall meet NEC codes for raceways seals and be classified to UL 723 for smoke and fire performance.

9) Sealant system shall utilize foaming dam strips to fill the space between the cables and duct prior to injecting the sealant.

10) Acceptable level of quality: equivalent to Polywater FST Foam or approved equal.

b. The following duct sealant system may be used for conduit risers and ground level applications where low levels of water or gas are present:

1) Sealant shall be provided to prevent ingress of water or gas into the conduit/duct systems. Sealant shall be provided at both ends of the conduit run.

2) Shall be 2-part, closed-cell urethane foam that reacts to set in 5-8 minutes at 70F.

3) Shall be capable of sealing ¾" up to 10" conduits with multiple cable configurations.

4) Shall be re-enterable and capable of withstanding temperatures from -20F to 200F; and be chemically resistant to gasoline, oils, dilute acids and bases.

5) Shall not affect the physical properties of wire or cable.

6) Shall have 25 psi compressive strength and shall have less than 4% water absorption.

7) Shall be capable of holding 11ft of water head pressure continuous.

8) Selant shall meet NEC codes for raceways seals, meet UL 94 fire rating HBF, and be UL recognized.

9) Acceptable level of quality: equivalent to Polywater AFT Foam or approved equal.

2.04 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 GENERAL

A. Measure, mix and place concrete, and compact as required in Division 03.

B. Provide no less than 3 inches of concrete between outside of a duct and the earth. Provide no less than 2 inches of concrete between adjacent ducts. Refer to Drawings for spacing requirements. Provide side forms for each duct bank.

C. Duct line concrete pours to be continuous between manholes or handholes and between manholes or handholes and structures.

D. Where duct lines pass through concrete walls, concrete envelopes shall be extended through the finished flush with inside surfaces. Watertight construction joints of an approved type shall be provided.

E. Unless otherwise indicated on the Drawings, duct banks shall be reinforced when laid on backfill covering new pipelines, roads, parking lots or any are subject to vehicular traffic. Beneath these areas, install reinforcing bars as shown on the Drawings, extending 10 feet beyond area needing protection.

F. Duct lines shall be laid in trenches on mats of gravel not less than 6 inches thick and well graded.

G. Provide red electrical duct banks for safety purposes.

H. Raceway terminations at manholes shall be with end bells for PVC conduit and insulated throat grounding bushings with lay-in type lugs for metal conduit.

3.02 PROJECT CONDITIONS AND COORDINATION

A. Coordination with other Underground Utilities

1. Locate existing underground utilities through use of an underground utility piping location services company. Locate existing underground utilities and piping before any excavation begins.

2. Coordinate conduit routing, duct bank and manholes with other new and existing underground utilities. Revise locations and elevations as required to suit field conditions and ensure conduits, duct runs, manholes, and handholes do not interfere with existing and new underground utilities and piping.

3.03 INSTALLATION

A. Provide excavation and backfilling required for ductbank manhole and handhole installation.

B. Make duct bank installations and penetrations through foundation walls watertight.

1. Provide conduit sleeves for new cast-in-place construction to accommodate conduit penetrations through foundation walls.

2. All core drilled or sleeved foundation wall penetrations shall be provided with a modular, mechanical type, sealing system.

C. Plug and seal all active and spare/empty ducts entering buildings, structures and manholes/handholes to prevent water-ingress. The seals shall be watertight, 2-part, closed-cell urethane foam.

D. Assemble duct banks using non-magnetic saddles, spacers, and separators. Position separators to provide 3-inch minimum separation between the outer surfaces of the ducts.

E. Firmly fix ducts in place during pouring of concrete. Carefully spade and vibrate the concrete to insure filling of all spaces between ducts.

F. Make bends with sweeps of not less than 48-inch radius or 5 degree angle couplings.

G. Make a transition from non-metallic conduit to PVC coated rigid galvanized steel conduit where duct banks enter structures or turn upward for continuation above grade. Terminate the ducts in insulated grounding bushings. Continue ducts inside buildings with steel, metallic conduit.

H. Where ducts enter manholes and handholes, terminate the ducts in suitable end bells.

I. Provide expansion/deflection fittings in accordance with the requirements specified in Section 26 05 33.

J. Do not backfill with material containing large rock, paving materials, cinders, large or sharply angular substances, corrosive material, or other materials that can damage or contribute to corrosion of ducts or cables or prevent adequate compaction of fill.

K. Slope duct runs for drainage away from buildings and toward manholes/handholes with a slope of approximately 4 inches per 100 feet.

L. After completion of the duct bank and prior to pulling cable, pull a mandrel, not less than 12 inches long and with a cross section approximately 1/4 inch less than the inside cross section of the duct, through each duct. Then pull a rag swab or sponge through to make certain that no particles of earth, sand or gravel have been left in the duct.

M. Install a bare stranded copper duct bank ground cable in each duct bank envelope. Make ground electrically continuous throughout the entire duct bank system. Connect ground cable to building and station ground grid or to equipment ground buses. In addition, connect ground cable to steel conduit extensions of the underground duct system. Provide ground clamp and bonding of each steel conduit extension, where necessary to maintain continuity of the ground system. Terminate ground conductor at last manhole or handhole for outlying structures.

N. Install a warning ribbon approximately 12 inches below finished grade over all underground duct banks. The identifying ribbon shall be a PVC tape, detectable metal backed, 3 inches wide, red color, permanently imprinted with CAUTION BURIED ELECTRIC LINE BELOW in black letters.

O. Install duct banks in conformance with NEC and NESC.

P. Install manholes and handholes where shown on Drawings. Verify final locations in field.

Q. Complete installation of manholes and handholes so that structures are watertight. Provide expansion/deflection fitting for each conduit entry into the manholes.

R. Provide sump opening in manhole floor.

S. Provide grading rings or brick stacks for manholes when required to adjust manhole cover to proper grade. Stacks shall be a minimum of 12 inches in height, constructed on the roof slab or cone section on which the manhole frame and cover shall be placed. The height of the stack shall be such as is necessary to bring the manhole frame to the proper grade.

T. Conduits to extend 3 inches above concrete slab surface, unless otherwise indicated. Conduits to be bushed to protect cables and provide means for grounding.

U. Duct bank conduit spacers: provide conduit spacers compatible with the conduit utilized. Install as applicable to maintain proper spacing and support. Stagger conduit joints by rows and layers to provide a duct line having maximum strength. During construction, protect partially completed duct lines from the entrance of debris by conduits plugs. As each section of a duct line is completed, a testing mandrel not less than 12 inches long with a diameter 1/4-inch less than the size of the conduit, shall be drawn through each conduit, after which a brush having the diameter of the duct, and having stiff bristles shall be drawn through until the conduit is clear of all particles of earth, sand and/or gravel; conduit plugs shall then be immediately installed. Provide a plastic pull rope, having a minimum of 3 additional feet at each end, in all spare ducts.

3.04 DUCT BANK INSTALLATION

A. Bends to have a radius greater than 36 inches or 12 times conduit inside diameter, whichever is greater.

B. Install duct with minimum slope of 4 inches per 100-feet. Slope duct away from building entrances.

C. Install no more than equivalent of three 90-degree bends between pull points.

D. Provide suitable fittings to accommodate expansion and deflection where required.

E. Use suitable separators and chairs installed not greater than 4-feet on centers. Conduit separation shall be per code, and not less than 3 inches.

F. Securely anchor duct to prevent movement during concrete placement. Use re-bar holders at spacers and secure with No. 4 re-bar driven into the earth at a minimum of 1-foot.

G. Connect to manhole wall using No. 6 re-bar dowels. Dowels shall be located at each corner, and 12 inches on center. Insert dowels minimum 3 inches into manhole and 3 feet into duct bank.

H. Tops of concrete-encased ducts

1. Not less than 24 inches and not less than shown on the Drawings, below finished grade

2. Not less than 30 inches and not less than shown on the Drawings, below roads and other paved surfaces

I. Tops of direct burial ducts and conduits

1. Not less than 24 inches and not less than shown on the Drawings, below finished grade

2. Not less than 30 inches and not less than shown on the Drawings, below roads and other paved surfaces

J. Make duct bank installations and penetrations through foundation walls watertight.

1. Unless otherwise indicated, all core drilled or sleeved wall penetrations through foundation walls shall be provided with modular, mechanical type, sealing systems

3.05 CONDUIT JOINT WATERPROOFING

A. Waterproofing of conduit joints shall conform to the following

1. Non-metallic PVC Conduit, temperature rated for 90 degrees C. The end of the conduit shall be liberally coated with approved wall weather quickset clear cement before joining. Joint shall be inserted into the coupling, pushing firmly and rotating conduit until it reaches the pre-formed stopping ridge within the coupling.

2. The entire work area of the joint, plus a minimum distance of 6 inches both ways, shall be thoroughly cleaned (with a solvent if recommended by the respective manufactures) removing all foreign debris such as dirt, sand and mud prior to the following Work being started.

3. Pipe insulating putty shall be applied to the entire circumference of the coupling ends to provide a smooth tapered surface.

4. Apply quick drying, non-sag, rubber-based primer to the conduit joints, extending the primer application the entire length of the proposed tape wrap.

5. Apply an all-weather, corrosion protection tape to the conduit joint area providing two full half-lap wraps the entire length of the joint; which is considered a minimum distance of 4 inches past the end of the coupling in both directions.

6. Install heat-shrinkable tubing to the conduit joint area. Tubing to extend a minimum of 2 inches past the end of the tape wrap in both directions.

3.06 CABLE PULLING

A. Inspection, handling, storage, temperature conditioning prior to installation, bending and training limits, pulling limits, and calculation parameters for installation of cables must comply with manufacturer’s recommendations. For ease of installation and prevention of cable damage, utilize quadrant blocks located properly along the cable run.

B. Provide soapstone, graphite, or talc cable lubricant for rubber or plastic jacketed cables.

C. Lubricants for assisting in the pulling or jacketed cables: specifically recommended by cable manufacturer.

D. Cable pulling tensions may not exceed the maximum pulling tensions recommended by the cable manufacturer.

E. Medium voltage cables: individually fire/arc proofed.

3.07 CABLE TERMINATING

A. Terminations of insulated power and lighting cables shall be protected from accidental contact, deterioration of coverings and moisture by the use of terminating devices and materials. Terminations shall be made using materials and method as indicated or specified or as designed by cable manufacturer and termination kit manufacturer.

3.08 GROUNDING

A. Ground duct banks with a bare stranded copper ground wire that is run within the duct bank and is bonded and grounded at both ends. Conduit may not be used as the ground conductor.

B. Ground manholes with ground rods. Use a bare stranded copper ground wire from the ground wire loop to bond together and ground the manhole cover frame, ladder support bracket, concrete inserts, cable racks, duct bank ground conductors, and shields of medium voltage cables that are spliced in the manhole.

C. Install a ground rod for each manhole. Bond exposed metal manhole accessories and concrete reinforcing rods with bare copper wire and connect to ground rod and ductbank ground cable. Provide foam sealant for rod penetration in manhole floor for watertight seal.

D. Install a bare stranded copper duct bank ground cable in each duct bank envelope. Make ground electrically continuous throughout the entire duct bank system. Connect ground cable to building and station ground grid or to equipment ground buses. In addition, connect ground cable to steel conduit extensions of the underground duct system, manholes, and handholes. Provide ground clamp and bonding of each steel conduit extension, where necessary to maintain continuity of the ground system. Where grounding systems/grids are not available at the end of the ductbank for connection of the ductbank ground wire, provide a ground rod at the end of the ductbank and bond to associated ductbank ground wire.

3.09 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.10 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.11 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 26 08 00

COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Perform Acceptance Tests for all electrical equipment furnished in accordance with this Section and applicable reference standards listed in Article 1.03.

   a. The test requirements for equipment shall be as required by applicable standards and manufacturer's recommendations, and in accordance with this Specification. In no case will the absence of test requirements be construed as alleviation of acceptance testing.

   b. The purpose of electrical field acceptance tests is to ensure that all electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with the Specifications and approved Shop Drawings.

   c. Tests are in addition to factory tests at the Manufacturer's facility, and may not substitute for same.

   d. Tests are in addition to all other tests specified under other Specifications and shall be coordinated by the Contractor.

   e. Tests in general shall be conducted after the equipment installation is complete. Tests shall be complete and in order given and/or in Specifications for the particular equipment unless otherwise approved by the Engineer.

   f. Tests are also intended to provide, ensure, or determine the following:

      1) Provide initial acceptance tests and recorded data that can be used as a benchmark for future routine maintenance and troubleshooting by plant personnel.

      2) Ensure a successful start-up with a minimum of last minute interruptions and problems.

      3) Determine the suitability of the equipment and systems for energization and placing into operation.

4) Provide assurance that each system component is not only installed satisfactorily but performs, and will continue to perform its function in the system with reasonable reliability throughout the life of the equipment.

B. Related Requirements

1. Section 26 05 00 – Common Work Results for Electrical

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. American National Standards Institute (ANSI)
2. American Society for Testing and Materials (ASTM)
3. Association of Edison Illuminating Companies (AEIC)
4. Canadian Standards Association (CSA)
5. Institute of Electrical and Electronic Engineers (IEEE)
6. Insulated Cable Engineers Association (ICEA)
7. International Electrical Testing Association (NETA)
8. National Electrical Manufacturer's Association (NEMA)
9. National Fire Protection Association (NFPA)
10. Occupational Safety and Health Administration (OSHA)
11. Underwriters Laboratory (UL)

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

1. Detailed test procedure including test equipment for all field acceptance testing prior to testing.

2. Submit 6 copies of test reports to the Engineer for approval.

3. Each test report shall include as minimum the following:

   a. Listing of equipment tested including the list of test equipment used and the test equipment's associated calibration dates

   b. Test method and standards governing the test

   c. Test results

   d. Recommendations

4. Test results shall incorporate inspection reports, instrument calibration curves, plotted test results, and all measurements and data.

5. All inspections, tests, and calibrations are to be reported in writing. The recorded data form shall have the signatures of the persons conducting the tests and authorized witnesses. The forms shall be designed to serve as the test and inspection checklist for inspection requirements. The test and checkout data shall also include any data taken prior to the adjustments, repairs, drying out, or similar Work prior to final testing and acceptance. As-found and as-left test data shall be recorded and reported in writing.

6. Copies of Test Data Reports shall be incorporated in each of the related Operations and Maintenance Manuals. The Data Reports shall include those items of equipment contained in the Service Manual. Reports shall be separated by a divider labeled Electrical Field Acceptance Tests. Reports shall contain data for all power conductors and controls including instrumentation conductors and devices for static and dynamic equipment in the Operations and Maintenance Manual. In addition, Operating Tests of the equipment shall be included in this section of the Operations and Maintenance Manual.

B. Closeout and maintenance material submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Qualifications: per Division 01 General Requirements for testing and as follows.

1. Engage the services of a recognized independent testing agency approved by the Engineer to perform acceptance tests as specified.

   a. The testing firm shall submit proof of the certification by NETS or NICET, and proof of the qualifications for the lead, on-Site technical person when requested.

2. The testing firm shall provide all material, equipment, labor, and technical supervision to perform such tests and inspections.

3. All cost associated with the testing shall be the responsibility of the Contractor, including the expenses of retest because of defects and failure of equipment to meet Specifications.

4. Wiring and equipment which is defective, or which fails to meet Specifications, shall be replaced by the Contractor, unless specific approval for repair is given by the Engineer. The Contractor shall bear the costs for either action.

5. Open circuits, place and connect all instruments and equipment needed for the tests, remove same and restore circuits when tests are complete.

6. Coordinate activities, and cooperate with others on Project, to ensure that systems are energized when required, loads applied, and requirements of other Specification Sections are carried out on timely, coordinated basis.

7. Other Specification sections may require services of one or more manufacturer's representatives, to ensure that equipment supplied has been installed properly and adjusted to proper working order. Advise representative of all applicable tests in this Section, so that Work will be coordinated, and tests combined where feasible.

8. Notify the Engineer, in writing; at least 14 calendar days before the test are to take place. The tests shall be conducted in the presence of the Engineer or his representative and shall not be started without his permission.

9. Perform all tests as closely as possible to conditions of actual use.

10. All testing and checkout Work shall be performed with fully qualified personnel skilled in the particular tests being conducted. This is essential for obtaining and properly evaluating data while the tests are in progress and for insuring that important facts and questionable data are reported.

11. It is important that equipment warranties or guarantees not be voided by the Contractor's testing and checkout Work. The tests will normally be supplemental to and compatible with the manufacturer's installation instructions and recommendations. Where deviations are apparent, the manufacturer's review and approval shall be obtained prior to testing. Reasonable cooperation is to be extended to permit witnessing by the manufacturer's representative if so requested. Where any questionable repairs, modifications, significant adjustments, tests or checks are to be made, contact the Owner to determine if the Work should be performed by or with the manufacturer's representative.

12. Ensure that all testing and checkout Work is conducted in a safe manner. Special safety pre-cautions such as the following to be utilized where appropriate:

    a. Occupational Safety and Health Act (OSHA)

    b. Accident Prevention Manual for Industrial Operations, National Safety Council

    c. Applicable state and local safety operating procedures

    d. Owner safety procedures

    e. National Fire Protection Association (NFPA 70E)

    f. American National Standards for Personnel Protection

    g. Locking procedures

    h. Barricades

    i. Maintenance of voice communications

    j. Erection of warning signs

    k. Stationing of guards and watchmen

    l. De-energize and/or isolate equipment prior to testing. Exceptions must be thoroughly reviewed to identify safety hazards and devise adequate safeguards.

13. The sequence of all tests and checks shall be such that the equipment can be energized immediately after the completion of the applicable tests.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Test Equipment

1. Provide all necessary test equipment and tools as specified and as recommended by the tested equipment manufacturer.

2. All test equipment shall be in good mechanical and electrical conditions and be calibrated per NETA ATS schedule requirements. Records which show date and results of instrument calibration or testing must be kept up-to-date and provided with the test report upon request.

3. The accuracy shall be directly traceable to the National Institute of Standards and Technology.

4. Calibrating standard shall be of higher accuracy than that of the instrument tested.

5. Test equipment shall include but not limited to and shall have operating accuracy equal to, or better than listed.

   a. Portable multimeters shall be true RMS measuring

   b. Multimeters shall have the following accuracy limits, or better (for 60 Hz where applicable)

      1) AC voltage ranges: 0.75 percent plus or minus 3 last single digits

      2) AC current ranges: 0.90 percent plus or minus 3 last single digits, including adapters, transducers

      3) DC voltage ranges: 0.25 percent plus or minus 1 last single digit

      4) Resistance ranges: 0.50 percent plus or minus 1 last single digit

      5) Frequency range: 0.10 percent plus or minus 1 last single digit

   c. Clamp-on ammeters: AC current plus or minus 3 percent of range plus or minus 1 last single digit

d. Dissipation/power factor field equipment

1) Plus or minus 0.1 percent power factor values up to 2.0 percent

2) 5 percent of the reading for power factor values above 2

e. Low-range DC resistance equipment: 1.0 percent of reading, plus or minus 2 last single digits

f. Transformers turns-ratio test equipment: 0.5 percent or better

g. Ground electrode test equipment: plus or minus 2.0 percent of range

h. Insulation (Megger) test sets: 0 - 1000V DC plus or minus 20 percent of reading at mid-scale for equipment 600 volts and less and 0 - 2500 volts DC plus or minus 20 percent of reading at mid-scale for equipment over 600 volts.

i. Electrical load survey equipment

1) Plus or minus 5 percent total error, including sensors

2) 1 percent resolution

3) Current transformers plus or minus 2 percent of range

4) Voltage transformers plus or minus 0.5 percent of range

j. Liquid dielectric strength test equipment: plus or minus 2 percent of scale

k. Infrared scanning equipment: sensitivity of 2 degrees C

l. Phase shifting equipment: plus or minus 1 degree over entire range

m. High-current test equipment: plus or minus 2 percent of range

n. DC high potential test equipment: plus or minus 2 percent of scale

o. AC high potential test equipment: plus or minus 2 percent of scale

p. Multi-amp SR-90, or equal, relay test set

2.02 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. All tests shall be performed with regard to protecting solid-state devices and electronic components from potential damage. Where applicable, disconnect solid-state devices and electronic components prior to applying testing voltage.

B. Make up no connections at service entrance, transformers, substations, motors, motor control centers, and switchgear permanently until correct phase rotation of all equipment is determined and electrical tests have been completed. Install and insulate these connections temporarily, if necessary. Make permanent connections after proper rotation has been established and subsequent to completion of insulation resistance and dielectric tests.

C. Wire and cable insulation resistance tests

1. Low voltage, 600V maximum

a. Inspect wire and cables for physical damage and proper connection in accordance with approved Shop Drawings.

b. Check color-coding with Specifications and NEC standards.

c. Perform continuity test to insure proper connection.

d. Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 1000 volts DC for 1 minute.

e. Evaluate test results by comparison with wires and cables of the same length and type. Investigate any values less than 50 Megaohms.

D. Grounding Systems

1. Verify that grounding system is in accordance with Specifications and applicable codes.

2. The grounding system shall be tested for continuity of connection and for resistance to flow of current through ground connections.

a. The resistance between the main grounding electrode and ground shall be no greater than 5 ohms for 600V systems. For electrical substation grounds the ground resistance shall be no greater than 1 ohm.

b. The ground resistance of conduits, equipment cases, and supporting frames shall be only fractionally higher than system ground.

c. Method of measurement of ground resistance shall be as specified by NETA-AST and be approved by the Engineer before the start of tests.

E. Circuit Breakers - Low Voltage

1. Circuit breakers are to be checked for possible damage during shipment or storage.

2. Inspect the breaker visually for physical damage.

3. Perform several mechanical ON-OFF operations.

4. Perform circuit continuity check on each pole with the circuit breaker in the closed position.

5. Determine short-time pickup and delay, long-time pickup and delay by primary current injection.

6. Tests solid-state trip devices at multiple setting range of pickup and time delays.

7. Apply 300 percent of breaker rated continuous current to each pole to determine that the circuit breaker will trip on an overload.

F. Power Transformers

1. The field acceptance tests for power transformers shall be performed as specified, and as recommended by the transformer manufacturer.

2. Perform visual and mechanical inspection, insulation resistance tests, dielectric absorption tests, turn ratio tests, oil sample tests, AC over potential tests, insulation power factor tests on all windings and bushings, individual exciting current tests on each phase, winding resistance tests, top gas analysis, oil PCB levels, and any special

3. Perform tests and adjustments as applicable, and as recommended by the transformer manufacturer.

4. Test values to be as recommended by manufacturer and specified by NETA-ATS.

5. Employ the services of the manufacturer and independent testing company to check, set and adjust the operation of the cooling equipment and demonstrate to the Owner that all equipment and alarms are functional and operational.

G. AC Motors - Induction Motors

1. Inspect for physical damage and compare nameplate information with Drawings and Specifications

2. Inspect for proper installation, grounding, connection, and lubrication. Motor alignment, wiring capacity, speed and operation shall be checked to verify compliance with Specifications.

3. Check for unusual mechanical or electrical noise or signs of overheating during initial test run.

4. Perform insulation-resistance tests in accordance with ANSI/IEEE Standard 43. Test duration as recommended by NETA-ATS.

5. Perform insulation-resistance test on pedestal per manufacturer's instructions.

6. Perform insulation-resistance test on surge protection device in accordance with NETA-ATS Specifications.

7. Check resistance temperature detector (RTD) circuits for conformance with Drawings. Check that metering or relaying devices using the RTD's are of the proper rating.

8. Check that the motor space heater is operating.

9. Perform a rotation test to insure proper shaft direction if the motor has been electrically disconnected.

10. Measure running current and evaluate relative to load conditions and nameplate full-load amperes.

11. Check motor operation.

    a. The motor shall be run for at least four-hours as close to full load as possible

H. AC Motors - Synchronous Motors

1. Inspect for physical damage and compare nameplate information with Drawings and Specifications.

2. Inspect for proper installation, grounding, connection, and lubrication.

3. Perform insulation-resistance tests on the main rotating field winding, the exciter field winding, and the exciter armature winding in accordance with ANSI/MEE Standard 43.

4. Measure and record resistances of the following:

   a. Motor-field winding

   b. Exciter-stator winding

   c. Exciter rotor windings

   d. Field discharge resistors

5. Check that the field application and power-factor relay enable time-delay relays have been tested and set to the motor drive manufacturer's recommended values.

6. Run the motor for at least 4 hours as close to full load as possible.

7. Test values to be in accordance with NETA-AST and NEMA publication.

I. Motor Control

1. Low and medium voltage motor controls shall be tested in accordance with NETA-ATS requirements and manufacturer recommendations.

J. Instrument Transformers

1. Inspect transformers for physical damage and nameplate information for compliance with Drawings and Specifications.

2. Verify proper connection of transformers with system requirements.

3. Verify tightness of all bolted connections and assure that adequate clearances exist between primary circuits to secondary circuit wiring.

4. Verify that all required grounding and shorting connections provide good contact.

5. Verify proper operation of transformer withdrawal mechanism (tip out) and grounding operation when applicable.

6. Electrical Tests - Current transformers

   a. Perform insulation-resistance tests on current transformer secondary and wiring to-ground winding at 1000 volts DC for 1 minute. Value of test voltage on secondary wiring shall be 1000 volts DC for 1 minute. Do not perform this test with solid-state devices connected.

b. Perform a polarity test on each transformer winding and verify manufacturer's polarity markings.

c. Perform a turns-ratio verification test of each current transformer.

d. The test data shall include the following:

1) Manufacturer's stated ratio for each tap position

2) Test turns ratio results

3) Percent error per tap position

4) Manufacturer's indicated polarity

5) Test result polarity

e. On each set of transformer windings, the turn's ratio shall be determined for all no-loads taps, using the two-voltmeter method for control transformers and the two-ammeter method for current transformers.

f. Confirm test switch wiring and operation.

1) A functional test shall be performed on the test switch of the current transformer to ensure that the secondary leads are shorted and that no open circuit conditions exist. A functional test shall also be performed on the control transformers to ensure that no short circuit exists across the secondary leads.

2) All control wiring shall be checked to ensure proper operation of the device being powered.

g. Perform other tests specified by the NETA-ATS as required by application.

7. Electrical Tests - Voltage Transformers

a. Perform insulation-resistance tests on voltage transformers, winding-to-winding and windings-to-ground. Value of test voltage on secondary wiring shall be 500 volts DC for 1 minute. Do not perform this test with solid-state devices connected.

b. Perform a polarity test on each transformer to verify the polarity marks or H1-X1 relationship as applicable.

c. Perform ratio test as specified in NETA-ATS.

d. Perform a dielectric withstand test on the primary windings with the secondary windings connected to ground. The DC dielectric voltage shall be in accordance with Table Switchgear Insulation-Resistance Test Voltage above.

K. Metering and Instrumentation

1. Inspect all devices for physical damage and tightness of electrical connections.

2. Check calibration and accuracy of meters at 25/50/75/100 percent of full scale.

3. Verify all instrument multipliers.

L. Operating Tests

1. Mechanical and electrical interlocks

a. Mechanical interlocks shall be examined to ensure the interlock is free to operate and that bearing surfaces are free to perform their intended function.

b. Checks for correct adjustment of primary disconnect mechanisms in plug-in units. Shall be mechanically interlocked with the door to ensure that the door is held closed with primary disconnect in the ON position.

c. Check for padlock provisions on disconnect operating mechanisms.

d. Check motor starters equipped with a defeater mechanism to ensure that they can be operated to release the door interlock with the disconnect device in the ON position.

2. Circuit Breaker Operation

a. Test trip all medium voltage circuit breakers from all devices in the trip circuit and verify operation of all interlocks.

b. Installation and inspection of 480V power circuit breakers shall be in accordance with NEMA Pub. No. SG-3:

1) Perform tests in accordance with NETA-ATS Specification and this Specification.

c. Test all remote control stations for operation.

1) A functional test shall be performed for all remote pushbutton stations and manual motor starters to ensure their proper operation.

2) Tests shall be as included in the appropriate standards.

3.02 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.03 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.04 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 26 09 16

ELECTRICAL CONTROLS AND RELAYS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Furnish and install the equipment in accordance with this Section and applicable reference standards listed in Article 1.03.

2. This section includes the supply and installation of a complete relay protection system for new equipment and modifications to existing equipment as detailed on the Drawings and as described in this Specification.

B. Related Requirements

1. Section 26 05 00 – Common Work Results for Electrical

2. Section 26 08 00 - Commissioning of Electrical Systems

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. The protective relays shall comply with the applicable portions of ANS/IEEE and NEMA standards.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. System description including an overview of the system provided with detailed description of system

C. Bill of Material including a complete listing of all relays, hardware, devices, training, and startup services being supplied

D. Wiring diagrams and control schematics representing the interconnection of the protective relays to the circuit breakers affected by their protective function.

E. Final submittal data shall include a systems operation manual, which includes all the information specified.

F. The operation manual shall include the following information.

1. A system description overview, descriptive bulletins and/or sales aids covering all components in the system.

2. A maintenance section including all instruction leaflets and technical data necessary to set-up, change set-up parameters, and maintain the communicating devices and sensors.

G. A detailed startup report, including a list of trained customer personnel shall be provided.

H. Published time-current curves (on full logarithmic paper) and instruction manuals of all protective relays.

I. Closeout and maintenance material submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Cutler-Hammer

B. General Electric

C. ABB

D. Schweitzer Engineering Laboratories

E. Or equal

2.02 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Equipment shall be installed in accordance with manufacturer's instructions and recommendations.

B. After installation, the equipment shall be field tested for operation and conformance in accordance with Division 26.

C. Perform field tests prior to energizing equipment in a staged sequence to minimize interruptions to the treatment plant. Equipment shall not be energized or placed back into operation without the permission of the Engineer. The field tests shall be witnessed by the Engineer and certified by the Contractor.

D. Field-testing for the protective relays shall be performed by and in accordance with the recommendations of the manufacturer’s representative.

3.02 FIELD SERVICES

A. Provide the services of a qualified factory-trained manufacturer’s representative to assist the Contractor in installation and start-up of the equipment specified under this section. The manufacturer’s representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained. A qualified service representative from the switchgear manufacturer shall perform field services after equipment delivery, shall be performed:

1. Assist in the installation of the equipment

2. Assist in the performance of field tests

3. Observe and assist initial operations

4. Train the plant operations and maintenance staff in the care, operation and maintenance of the equipment

B. A qualified factory-trained manufacturer’s representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer’s recommendations.

C. Provide equipment start-up services and training in accordance with Division 26.

D. Provide a field report from the manufacturer's representatives for each visit to the Site. The report shall include complete information on time, schedule, tasks performed, persons contacted, problems corrected, tests results, training, instruction and all other pertinent information.

3.03 ACCEPTANCE TESTING

A. Provide and perform acceptance testing for the new protective relays in after the completion of the field tests. The acceptance testing shall be witnessed by the Engineer, Owner and certified by the Contractor.

B. Acceptance testing inspection shall be performed, in a staged sequence to minimize interruptions to the facility. Inspection shall include the following

1. Physical, electrical and mechanical conditions shall be inspected

2. All connections shall be inspected for high resistance

3. Electrical and mechanical interlock systems and control circuits shall be checked for proper operation

4. Protective relays and instruments shall be inspected for proper operation

5. Pickup and timing tests shall be performed for each protective relay

C. All tests and values shall be in accordance with the manufacturer's recommendations and NETA, ATS Acceptance Testing Specifications.

D. Provide an acceptance testing report. The report shall be in accordance with NETA, ATS Acceptance Testing Specifications.

3.04 FIELD ADJUSTMENTS

A. The relays shall be set in the field by a qualified representative of the manufacturer, retained by the Contractor.

3.05 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.06 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.07 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide panelboards in accordance with this Section and applicable reference standards listed in Article 1.03.

2. This section includes power distribution panelboards, and lighting and power panelboards rated 600 volts or less.

B. Related Requirements

1. Section 26 05 00 – Common Work Results for Electrical

2. Section 26 05 26 – Grounding and Bonding for Electrical Systems

3. Section 26 05 33 – Raceways and Boxes for Electrical Systems

4. Section 26 43 00 – Surge Protective Devices

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. National Electrical Manufacturers Association (NEMA)

a. NEMA AB 1- Molded Case Circuit Breakers

b. NEMA PB 1 – Panelboards

c. NEMA PB 1.1 – Instructions for Safe Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less

2. National Fire Protection Association (NFPA)

a. NFPA 70 National Electrical Code

3. Underwriters Laboratories (UL)

   a. UL 50 – Enclosures for Electrical Equipment

   b. UL 67 – Panelboards

   c. UL 489 – Molded – Case Circuit Breakers and Circuit Breaker Enclosures

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

1. Product data for each type of panelboard specified.

2. Approval documents to include Drawings containing overall panelboard dimensions, interior mounting dimensions, and wiring gutter dimensions. Location of the main, branches, and solid neutral to be clearly shown and illustrate one line diagrams with applicable voltage systems.

3. Panel schedules for installation in panelboards. Submit final versions after load balancing.

B. Furnish manufacturer's product data, test reports, and materials certifications as required.

C. Closeout and maintenance material submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Square D by Schneider Electric

B. ABB

C. Eaton/Cutler Hammer

D. Siemens

E. Or equal

2.02 POWER DISTRIBUTION PANELBOARDS

A. Panelboard Interior

1. Provide power distribution panelboards rated 600 Vac or 250 Vdc maximum. Continuous main current ratings as indicated on associated schedules not to exceed 1200 amperes maximum. Panelboard bus current ratings shall be determined by heat-rise tests conducted in accordance with UL 67.

2. Provide UL Listed short circuit current ratings (SCCR) as indicated on the associated schedules not to exceed the lowest interrupting capacity rating of any circuit breaker installed with a maximum of 200,000 RMS symmetrical amperes. Main lug and main breaker panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and NEC Articles 230.VI and VII.

3. The panelboard interior shall have 3 flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. The molded polyester insulators shall support and provide phase isolation to the entire length of bus.

4. The bussing shall be fully rated with sequentially phased branch distribution. Panelboard bussing rated 100 through 600 amperes shall be aluminum. Bussing rated 800 amperes and above shall be plated copper. Bus bar plating shall run the entire length of the bus bar. The entire interleaved assembly shall be contained between two (2) U-shaped steel channels, permanently secured to a galvanized steel-mounting pan by fasteners.

5. Interior trim shall be of dead-front construction to shield user from all energized parts. Main circuit breakers through 800 amperes shall be vertically mounted. Main circuit breaker and main lug interiors shall be field convertible for top or bottom incoming feed.

6. A solidly bonded equipment ground bar shall be provided.

7. Solid neutral shall be equipped with a full capacity bonding strap for service entrance applications. Gutter-mounted neutral will not be acceptable.

8. Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, UL Listed label, and Short Circuit Current Rating shall be displayed on the interior or in a booklet format. Leveling provisions shall be provided for flush mounted applications.

B. Group Mounted Circuit Breakers through 1200A

1. Provide group mounted plug-on circuit breakers with mechanical restraint on a common pan or rail assembly.

2. The interior shall have 3 flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. The molded polyester insulators shall support and provide phase isolation to the entire length of bus.

3. Circuit breakers equipped with line terminal jaws shall not require additional external mounting hardware. Circuit breakers will be held in mounted position by a self-contained bracket secured to the mounting pan by fasteners. Circuit breakers of different frame sizes shall be capable of being mounted across from each other.

4. Line-side circuit breaker connections are to be jaw type.

5. All unused spaces provided, unless otherwise specified, shall be fully equipped for future devices, including all appropriate connectors and mounting hardware.

C. Electronic Trip Molded Case Standard Function 80 Percent Rated Circuit Breakers

1. Electronic circuit breakers shall have the following time/current response adjustments: Long Time Pickup, Long Time Delay, Short Time Pickup, Short Time Delay, Ground Fault Pickup, Ground Fault Delay, and Instantaneous settings. Each adjustment shall have discrete settings (fully adjustable) and shall be independent of all other adjustments.

2. Circuit breaker trip system: microprocessor-based true RMS sensing designed with sensing accuracy through the thirteenth harmonic. Sensor ampere ratings: as indicated on the associated schedule or Drawings.

3. Local visual trip indication for overload, short circuit and ground fault trip occurrences.

4. Long time pickup indication to signal when loading approaches or exceeds the adjustable ampere rating of the circuit breaker shall be provided.

5. Furnish thermal magnetic molded case circuit breakers for 250A frames and below.

D. Thermal Magnetic Molded Case Circuit Breakers

1. Molded case circuit breakers shall have integral thermal and instantaneous magnetic trip in each pole.

2. Circuit protective devices: molded case circuit breakers. Circuit breakers: standard interrupting. Ampere ratings: as shown on Drawings.

E. Enclosures

1. See specification 260533 Raceways and Boxes for Electrical Systems MGS2 for requirements.

2.03 LIGHTING AND APPLIANCE PANELBOARDS

A. Provide lighting and appliance panelboards designed for three phase, four wire, solid neutral, 60-hertz service rated for 480/277 volt or 120/208V service as indicated. Where main circuit breakers are indicated on the Drawings, provide main circuit breaker type interiors. Back-fed branch circuit breakers shall not be utilized for main circuit breakers.

B. Panelboards shall be flush or surface mounted, etc., as indicated by panel schedule; code gauge galvanized steel boxes and enameled steel fronts sized for minimum 6-inch minimum side, top and bottom gutters, or greater as required by NEC.

C. Each panel to have door in door trim with full length piano hinge to allow for access to wireways.

D. Each panel to have door provided with cylinder lock and latch allowing for common key access to each panel. Each panel to have fully typed directory indicating outlets, fixtures, devices and locations served by intended circuit. Panelboards for use as service disconnecting means to conform to UL 869A.

E. Mechanical lugs furnished with panelboards shall be cast copper or copper alloys of sizes suitable for the conductors indicated to be connected thereto. Panelboards shall have fully capacity neutral bus, ground bus and bolt-on circuit breakers.

F. Circuit breakers shall be molded-case, thermal-magnetic, quick-make, quick-break, bolt-in type. Interrupting rating of circuit breakers shall be as indicated. Provide with suitable handle locks where indicated. Where interrupting rating is not indicated, panels for 120/208 volts service shall have breakers with 10,000 ampere RMS minimum interrupting rating at 240 volts, main circuit breakers where indicated shall have 25,000 ampere RMS minimum interrupting rating at 240 volts. Panels for 480/277 volt service shall have breakers with 14,000 ampere RMS minimum interrupting rating at 480 volts.

2.04 SPD DEVICES

A. Refer to Section 26 43 00 – Surge Protective Devices for specific requirements.

B. IEEE C62.41, integrally mounted, plug-in style, solid-state, parallel-connected, sine-wave tracking suppression and filtering modules.

C. Minimum single-impulse current rating as follows.

1. Line to Neutral: 100,000A

2. Line to Ground: 100,000A

3. Neutral to Ground: 50,000A

D. Protection modes as follows.

1. Line to neutral

2. Line to ground

3. Neutral to ground

E. EMI/RFI noise attenuation using 50-ohm insertion loss test: 55dB at 100kHz.

F. Accessories to include the following.

1. Form-C contacts, one normally open and one normally closed, for remote monitoring of system operation. Contacts to reverse position on failure of any surge diversion module.

2. Audible alarm activated on failure of any surge diversion module.

2.05 ENCLOSURES

A. Reference Section 26 05 33 – Raceways and Boxes for Electrical Systems for approved enclosure types.

2.06 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 PANELBOARDS

A. Install panelboards and accessory items according to NEMA PB 1.1 and manufacturers' written installation instructions.

B. Mount top of trim 6-feet and 2 inches above finished floor, except as indicated.

C. Circuit directory: typed and reflective of final circuit changes required to balance panel loads. Obtain approval before installing. Number branch circuit devices accordingly to correspond to circuit directory.

D. After substantial completion, conduct load balancing measurements and circuit changes. Should the difference at any panelboard between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.

E. Make equipment grounding connections for panelboards as indicated.

F. Provide ground continuity to main electrical ground bus indicated.

G. Include the following items performed during electrical tests in accordance with manufacturer's instructions.

1. Ground resistance test on system and equipment ground connections.

2. Test main and subfeed overcurrent protective devices.

3.02 CLEANING

A. Upon completion of installation, inspect panelboards and transformers. Remove paint splatters and other spots, dirt, and debris. Touch-up scratches and finish marks to match original finish.

3.03 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.04 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.05 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide labor, tools, equipment, and materials to furnish and install wiring devices in accordance with this Section and applicable reference standards listed in Article 1.03.

B. Related Requirements

1. Section 26 05 00 – Common Work Results for Electrical
2. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables
3. Section 26 05 26 – Grounding and Bonding for Electrical Systems
4. Section 26 05 33 – Raceways and Boxes for Electrical Systems

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. FM Global (FM)
2. National Electrical Code (NEC)
3. National Electrical Manufacturers Association (NEMA)
4. Underwriters Laboratories (UL)
    a. UL 20 General-Use Snap Switches
    b. UL 217 Standard for Safety Smoke Alarms

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Furnish manufacturers product data, test reports, and materials certifications.

C. Closeout and maintenance material submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 FLUSH WIRING DEVICES

A. Wall Switches

1. Provide white, specifications grade, toggle operated, quiet type alternating current (ac) switches, NEMA heavy duty class, rated at 20 ampere, 120/277v. Provide white, matching two pole, 3-way or 4-way switches as specified. Comply with UL 20 and NEMA standards.

2. Where 2 or more switches are to be installed at the same location, mount in one-piece ganged switch boxes, with appropriate gang cover plate.

3. Provide waterproof switches where indicated.

B. Receptacles

1. Convenience receptacles for interior use shall be commercial specification grade, 20-ampere, 125-volt ac, 2-pole, 3-wire, back and side wired, metal plaster ears, single, duplex (as indicated) grounded, conforming to NEMA FB 11, NEMA WD 1 and to the 5-20R configuration in NEMA WD 6. Receptacles shall be white in color. Provide waterproof in-use covers where indicated and required.

a. USB Receptacles

1) Where indicated on the Drawings, provide convenience receptacles with integral USB charging ports. Units shall be Dual Port with one (1) Type A USB Port and one (1) Type C USB Port.

b. Controlled Receptacles:

1) Where indicated on the Drawings, provide convenience receptacles with factory “Controlled” marking. Controlled receptacles shall be configured so the top outlet is controlled, and bottom outlet is live at all times.

2) Where controlled quadruplex receptacles are indicated on the Drawings, one duplex receptacle shall be controlled, and the second duplex shall be live at all times.

2. Ground Fault Interrupter (GFI) Receptacles shall be Commercial specification grade. Provide 20 ampere, "feed through" type ground fault circuit interrupter, with NEMA 5 20R duplex receptacles arranged to protect connected downstream receptacles on same circuit. Provide unit designed for installation in a 2 3/4-inch-deep outlet box without adapter, grounding type, Class A, Group 1. Receptacles shall be white in color. Provide waterproof in-use covers where indicated and required.

3. Provide NEMA WD 6 locking receptacles. Furnish 1 plug with each locking receptacle.

4. Receptacles to meet requirements for retention of plugs, overload, temperature, and assembly security in accordance with NEMA WD 1.

5. Special purpose outlets: NEMA heavy duty class, grounding type with matching plug. Coordinate NEMA type with equipment manufacturer.

C. Device Plates

1. Wall plates for flush wall switches and receptacles shall be the appropriate type and size and shall match the wiring devices for which they are intended. Dimensions for openings in wall plates shall be in accordance with NEMA WD 1.

2. Plates in Mechanical and Electrical rooms for receptacles, switches, tele/data, etc. shall be Galvanized steel, smooth rolled outer edge sized to fit box.

3. Device plates in the Laboratory, Utility Room, Break Room, Restrooms, Corridors and Lobby for receptacles, switches, tele/data, etc. shall be stainless steel.

4. Device Plates in Office Spaces and Conference Rooms shall be impact resistant plastic, white in color.

5. Process area: Plates in process areas for receptacles, telephone, etc., shall Galvanized steel, smooth rolled outer edge sized to fit box.

6. Device plates in general areas for receptacles shall be stainless steel.

7. Device Plates in finished spaces (office) shall be impact resistant plastic, white in color.

D. Weatherproof Device Plates

1. Provide weatherproof device plates where indicated and required.

2. Interior and Exterior Wet Locations: Device plates for interior and exterior wet locations shall be die-cast aluminum, gasket, with corrosion resistant screws to match plate cover finish. Provide weatherproof receptacles with vertical “in-use” covers for complete weatherproofing when plug is inserted.

2.02 CONTROL RELAYS

A. Acceptable level of quality: equivalent to Allen Bradley Bulletin 700-H Series, Square D.

B. 120V coil as required or as indicated.

C. Number of poles as indicated or required.

D. Electrically held, except as noted.

E. NEMA-1 enclosure except as noted.

2.03 MOTOR CONTROL RELAYS/CONTACTORS

A. Acceptable level of quality: equivalent to Allen Bradley, Square D.

B. 120V and 277V coils as required or as indicated

C. Number of poles as indicated or required.

D. Horsepower rated for connected motor.

E. Electrically held, except as noted.

F. NEMA-1 enclosure, except as noted.

G. 600V rated.

2.04 CONTROL STATIONS

A. Provide industrial, heavy duty type control stations with oil-tight construction and clearly marked legend plates. Provide enclosures based on location in accordance with NEMA requirements and as required for area classifications specified and NEMA rating to meet environmental conditions of installed location.

B. Provide common or grouped enclosures mounted for devices in the same location. Devices to include front mounted nameplates identifying function.

C. Provide control stations by one of the following manufacturers.

1. Allen Bradley Company

2. Appleton Electric Company

3. Crouse-Hinds Company

4. Or equal

D. Selector Switches

1. Provide non-illuminated, standard knob operated selector switches rated for use at 120VAC with white knob operator insert. Provide rotary type units with round or oval handles and positioning device to securely hold switch in selected position. Provide key type selector switches where shown on Drawings.

2. Provide compatible nameplate for each selector switch identifying intended functions: (i.e. HAND/OFF/AUTO, LOCAL/OFF/REMOTE, JOG/OFF/AUTO, etc.) as indicated on Drawings.

3. Provide 30.5mm selector switch units.

E. Pushbuttons

1. Provide non-illuminated momentary or maintained type switches rated for use at 120 VAC. Provide green switches for START pushbuttons and red switches for STOP pushbuttons.

2. Provide compatible nameplate for each pushbutton identifying intended functions (i.e. STOP, START).

3. Provide mushroom style, 2-position push-pull emergency stop operators with number of contacts indicated on Drawings. Provide stations with push-pull padlocking attachment and legend plate reading: PUSH TO STOP, PULL TO START.

4. Provide 30.5mm pushbutton units.

2.05 THERMOSTATS

A. Line-Voltage Thermostats: (TIT-XXX & TIT-XXX)

1. Provide line voltage electric thermostats, suitable for application and location installed. Provide sensors with a two-wire connection to the controller that is polarity and wire type insensitive. Provide with manual adjustment dials to provide maximum and minimum range of approximately minus 10 degrees to 100 degrees F. Unit to have form C dry contact for low temperature alarm monitoring via the facilities SCADA control panel. Acceptable level of quality for electric thermostats: equivalent to Dayton, Model 2E815.

B. Analog Thermostats: (TIT-XXX & TIT-XXX)

1. Provide wall mount analog thermostats with integral wall mounting bracket/mounting plate. Temperature transmitter to have a temperature range of minus 40 degrees to 150 degree C (-40 to 302 degree F). Transmitter to have a 4-20mA (0-10vdc) output for monitoring via the facilities SCADA control panel. Unit power to be 8-32vdc. Acceptable level of quality for unit: equivalent to IFM Efector600, Model TN2531.

2.06 DOOR INTRUSION SWITCHES

A. Provide UL non-contact interlock position door intrusion switches with a switching voltage of 120 VAC, 0.2A. Switch to have a nominal break range of 1.2 inches, minimum lead lengths of 12 inches, conduit connection of 1/2-inch NPT, and a hermetically sealed N.O. contact configuration. Enclosure to be Nylon 6/6 and NEMA rating of 4X. Provide intrusion switches with a load rating of 84W. Acceptable level of quality for intrusion switch: equivalent to GE or Allen Bradley.

B. Overhead Door Switch

1. Overhead door switches to be specifically listed for use with overhead doors with magnetic contact. Acceptable level of quality: equivalent to GE Model 2202.

2. Floor-mount magnetic contact for overhead doors, cast aluminum housing, 3 in gap size, SPDT contacts, and include minimum 18 inch stainless steel armored cable.

C. Provide door intrusion switches suitable for use in I.S. (Intrinsically Safe) circuits when wired through certified intrinsically safe barriers. Provide I.S. intrusion switches in classified locations indicated on Drawings.

2.07 DOOR BUZZER & PUSHBUTTON

A. Acceptable level of quality for door buzzer: equivalent to Edwards No. 115-4G5 (24VAC) with Edwards transformer No. 598, Federal Signal.

B. Acceptable level of quality for pushbutton: equivalent to Edwards No. 1786B, Federal Signal.

2.08 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 WIRING DEVICES

A. Wall Switches and Receptacles

1. Wall switches and receptacles shall be so installed that when device plates are applied, the plates will be aligned vertically to within 1/16-inch.

2. Ground terminal of each flush-mounted receptacle shall be bonded to the outlet box with an approved green bonding jumper.

B. Device Plates

1. Device plates and receptacle cover plates for receptacles and light switches shall be suitably labeled, identifying the circuit number and the panel name; for example: RP1-12.

2. Device plates shall be identified on the inside of the plate by circuit number and panelboard.

C. Control Stations

1. Mount equipment so that sufficient access and working space is provided for ready and safe operation and maintenance.

2. Securely fasten equipment to walls or other surfaces on which they are mounted. Provide independent galvanized steel supports where no wall or other surface exists.

3. Install in conformance with NEC.

3.02 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.03 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.04 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 26 28 13

FUSES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide fuses in accordance with this Section and applicable reference standards listed in Article 1.03.

B. Related Requirements

1. Section 26 05 00 – Common Work Results for Electrical
2. Section 26 05 26 – Grounding and Bonding for Electrical Systems
3. Section 26 08 00 – Commissioning of Electrical Systems
4. Section 26 28 16 – Enclosed Switches and Circuit Breakers
5. Section 26 29 13 – Enclosed Controllers

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards.

1. National Fire Protection Association (NFPA)
    a. NFPA 70 National Electrical Code Underwriters Laboratories
2. Underwriters Laboratories (UL)
    a. UL 198B: Class H Fuses
    b. UL 198C Class CC, G, J and L Fuses
    c. UL 198D Class K Fuses
    d. UL 198E Class R Fuses
    e. UL 198F Plug Fuses
    f. UL 198G Miscellaneous Cartridge Fuses

g. UL 198H Class T Fuses

h. UL 198L DC Fuses

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

B. Coordinate fuse ratings with HVAC, refrigeration and mechanical equipment nameplate limitations of maximum fuse size. Provide fuse sizes and types as recommended by equipment manufacturers.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data: include the following for each fuse type indicated.

1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.

2. Let-through current curves for fuses with current-limiting characteristics.

3. Time-current curves, coordination charts and tables, and related data.

4. Field test reports indicating and interpreting test results.

C. Ambient Temperature Adjustment Information. If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses adjusted.

1. For each adjusted fuse, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.

2. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

D. Shop drawing of spare fuse cabinet showing dimensions and features including storage provision for fuse cartons.

E. Maintenance data for tripping devices to be included in the “Operating and Maintenance Manual”.

F. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Source Limitations: Provide fuses from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by Underwriting Laboratories, Inc. or a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms “Listed” and “Labeled”: As defined in the “National Electric Code”, Article 100.

2. Listing and Labeling Agency Qualifications: A “Nationally Recognized Testing Laboratory” (NRTL) as defined in OSHA Regulation 1910.7

E. Single-Source Responsibility: All fuses shall be the product of a single manufacturer.

F. Comply with NEMA FU 1.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

B. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.09 MAINTENANCE

A. Furnish extra materials described below that match products installed and that are packaged in original cartons or containers and identified with labels describing contents.

1. Spares: For of each fuse type and size the following:

a. Potential Transformer Fuses: 3

b. Control-Power Fuses: 3

c. Fuses and Fusible Devices for Fused Circuit Breakers: 3

d. Fuses for Fused Switches: 6

e. Fuses for Fused Power-Circuit Devices: 3

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.; Bussmann Div.
2. Ferraz Shawmut Corp.
3. General Electric Co.
4. Littelfuse, Inc.
5. Or equal

2.02 FUSES – GENERAL

A. Provide fuses for equipment provided under this and other Sections of the types and rating as shown on the Drawings. Coordinate with equipment manufacturers and with work of other sections.

B. Fuses for Direct Current Circuits: Marked for such use by the manufacturer on the fuse label.

C. Voltage: Fuses shall be suitable for the circuit phase to phase voltage.

2.03 FUSE APPLICATIONS

A. Main Service: Class L, time delay.

B. Feeders for all loads larger than 600 Amps: Class J or Class L, time delay.

C. Motor Load Feeders: Class RK5, time delay.

D. Lighting Load Feeders: Class RK1 time delay.

E. Motor Branch Circuits: Class RK1 or Class RK5, time delay.

F. Other Branch Circuits: Class RK1 or Class RK5.

G. Fuses shall be available in the following standard current ratings: 1, 3, 6, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100, 110, 125, 150, 175, 200, 225, 250, 300, 350, 400, 450, 500, 600, 700, 800, 1000, 1200, 1600, 2000, 2500, 3000, 4000, 5000 and 6000 amperes.

H. Time-delay fuses shall be dual-element type, with separate overload and short circuit elements in separate chambers.

I. Fuses rated over 600 Amps shall be silver-sand type, and shall be time-delay, capable of holding 500% of rated current for a minimum of 4 seconds.

J. Time-delay fuses rated at 600 Amps or less shall be capable of holding 500% of rated current for a minimum of 10 seconds (except for 250 V/30 A, which shall be capable of holding 500% for a minimum of 8 seconds).

K. Fuses for motor branch circuits shall be sized as follows, unless otherwise specified on the contract drawings:

1. Fuses for motors with service factor of 1.15 or greater, protected by proper overload relays, shall be sized for 125% of motor full load current (or next higher standard rating), except in areas of high ambient temperature, or for motors with loads that require a long to reach full speed, for which fuses shall be sized at 150% to 175% motor full load current.

2. Fuses for motors with service factors less than 1.15 protected by proper overload relays, shall be sized for 115% of motor full load current (or next higher standard rating).

3. Fuses for motors with service factor of 1.15 or greater, without separate proper overload protection, shall be sized for 125% of motor full load current or next lower standard rating; fuses for motors with service factor of less than 1.15, without separate proper overload protection, shall be sized for 115% of motor full load current or next lower standard rating.

L. Current-limiting fuses shall have the following characteristics:

1. Fuses shall clear circuits within ½ cycle after fault initiation.

2. Provide peak-let-through current charts for each type of current-limiting fuse provided.

M. All fuse contact surfaces shall be plated.

N. Fuse body shall be constructed of high temperature, dimensionally stable, long-life, non-hygroscopic material.

O. Fuse type, class and ratings shall be chosen so as to provide a fully selective protection system.

2.04 CLASS L TIME DELAY FUSES

A. All purpose silver-linked fuse for both overload and short-circuit protection for high capacity systems, mains and large feeders.

B. Time delay, minimum of four seconds at five times Amp rating, for close sizing.

C. Interrupting rating of 300,000 Amps RMS Symm complies with NEC.

D. High grade silica-sand filler; accelerates response of fuse to short-circuits by having quenching effect upon the fuse arc.

E. 99.9% pure silver fuselinks.

F. Glass melamine tube.

G. Silver plated end bells.

2.05 CLASS RK1 TIME DELAY FUSES

A. Current limiting for maximum short-circuit protection.

B. Type 2 protection for IEC and NEMA starters when properly sized.

C. High inrush current motor protection.

D. Time delay permits 130% FLA sizing for back-up motor damage.

E. Interrupting rating of 300,000 Amps RMS Symm complies with NEC.

2.06 CLASS RK5 TIME DELAY FUSES

A. Provides motor overload, ground fault and short-circuit protection.

B. Helps protect motor against burnout from overloads and single phasing when sized properly.

C. Simplifies and improves blackout prevention (selective coordination).

D. Dual-element fuses can be applied in circuits subject to temporary motor overloads and surge currents to provide both high performance short circuit and overload protection.

E. The overload element provides protection against low level overcurrent of overloads and will hold on inrush current which is five times greater than the ampere rating of the fuse for a minimum of ten seconds.

F. Interrupting rating of 200,000 Amps RMS Symm.

2.07 CLASS J TIME DELAY FUSES

A. True dual-element fuses with a minimum 10 second time-delay at 500% overload.

B. Long time-delay minimizes needless fuse openings due to temporary overloads and transient surges.

C. Can often be sized for back-up protection against motor burnout from overload or single-phasing if other overload protective devices fail.

D. High interrupting rating to safely interrupt overcurrents up to 300,000 Amps.

E. High degree of current limitation due to the fast speed of response to short-circuits.

F. Reduces let-through thermal and magnetic forces in order to protect low withstand rated components.

G. Proper sizing provides no damage “Type 2” coordinated protection for NEMA and IEC motor control in accordance with IEC Standards.

2.08 CLASS T FUSES

A. Small, space saving fuses provide a high degree of current limitation on short circuits for excellent component protection.

B. Commonly applied in electric heat circuits, load center, disconnect switches, and meters.

C. The small size of these fuses permits installation in panelboards and control centers for system upgrading when existing circuit breakers cannot safely interrupt larger available short-circuit currents.

D. High-speed of response for semiconductor protection.

2.09 SPARE FUSE CABINET

A. Wall mounted, sheet metal cabinet with shelves, suitably sized to store spare fuses and fuse pullers.

B. Doors shall be hinged with hasp for Owner’s padlock.

C. Finish shall be gray baked enamel, and shall match panelboards.

D. Nameplate on door shall indicate “SPARE FUSES”.

2.10 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so manufacturer, rating, type and size information are readable without removing fuse.

B. Fuses shall not be installed until its associated equipment is ready to be energized.

C. Final equipment test, inspections and cleaning shall be performed prior to equipment energization.

D. Install fuses in associated equipment in accordance with equipment manufacturer's instructions.

E. Install spare fuse cabinet where indicated.

3.03 IDENTIFICATION

A. Install typewritten labels indicating fuse replacement information on inside door of each fused switch.

3.04 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.05 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.06 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide individually mounted enclosed switches and circuit breakers in accordance with this section and applicable reference standards listed in Article 1.03.

B. Related Requirements

1. Section 26 05 00 – Common Work Results for Electrical

2. Section 26 05 26 – Grounding and Bonding for Electrical Systems

3. Section 26 05 33 – Raceways and Boxes for Electrical Systems

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. National Fire Protection Association (NFPA)

a. NFPA 70 National Electrical Code

2. Underwriters Laboratories

a. UL 98 Enclosed Switches

b. UL 508 Industrial Control Equipment.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

B. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data for each type of switch, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

C. Shop Drawings for each switch and circuit breaker.

1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Enclosure types and details.

b. Current and voltage ratings.

c. Short-circuit current rating.

d. UL listing for series rating of installed devices.

e. Features, characteristics, ratings, and factory settings of individual over-current protective devices and auxiliary components.

f. Time-current curves, including selectable ranges for each type of circuit breaker.

2. Wiring Diagrams: power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.

D. Field Test Reports: written test reports:

1. Test procedures used.

2. Test results that comply with requirements.

3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Manufacturer's field service report.

F. Maintenance Data for enclosed switches and circuit breakers and for components to include in maintenance manuals.

1. Routine maintenance requirements for components.

2. Manufacturer's written instructions for testing and adjusting switches and circuit breakers.

3. Time-current curves, including selectable ranges for each type of circuit breaker.

G. Closeout and maintenance material submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NEMA AB 1 and NEMA KS 1.

D. Comply with UL 98 and UL 508.

E. Product selection for restricted space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

1. Environmental limitations: rate equipment for continuous operation under the following conditions, unless otherwise indicated:

2. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C)

3. Altitude: Not exceeding 6600 feet (2000 m)

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Square D by Schneider Electric

B. Eaton/Cutler-Hammer

C. ABB

D. Or equal

2.02 ENCLOSED SWITCHES

A. Enclosed, Non-fusible Switch: NEMA KS 1, heavy duty type with lockable handle.

B. Rating: Voltage and number of poles as required for motor or equipment circuits being disconnected. Switches used for service entrance equipment shall bear a UL label and be rated for service entrance equipment.

C. Enclosed switches serving motors driven by Variable Frequency Drives (VFDs) shall be provided with "Early Make" Auxiliary Contacts for interlock with associated VFD for safe shutdown as shown on the Contract Drawings.

D. Enclosed, Fusible Switch, 800A and Smaller: NEMA KS 1, heavy duty type with clips to accommodate specified fuses, lockable handle with two padlocks, and interlocked with cover in closed position.

2.03 ENCLOSED CIRCUIT BREAKERS

A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable instantaneous, magnetic trip setting for circuit-breaker frame sizes 150 Amp through 400 Amp.

B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles. Lugs shall be mechanical style suitable for number, size, trip ratings, and material of conductors.

C. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.

D. Electronic Trip Unit Circuit Breakers (Frame sizes 400 Amp and larger): RMS sensing, interchangeable harmonic trip unit, LED trip indicators with the following field-adjustable settings:

1. Long-time pickup levels and adjustments (L)

2. Short-time pickup levels adjustments (S)

3. Instantaneous trip adjustments (I)

4. Ground fault pickup level, time delay, I2t response and adjustments (G)

E. The circuit breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. Provisions for padlocking the circuit breaker in the OFF position shall be provided. Enclosures shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and prevent turning the circuit breaker ON when the enclosure cover is open. The cover interlock mechanism shall have an externally operated override, but the override may not permanently disable the interlock mechanism. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

2.04 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.

1. Reference Section 26 05 33 for approved enclosure types for each area of installation.

2.05 FACTORY FINISHES

A. Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard grey paint applied to factory-assembled and -tested enclosures before shipping.

2.06 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements. Comply with applicable reference standards listed in Article 1.03.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Mount equipment so that sufficient access and working space is provided for ready and safe operation and maintenance.

B. Securely fasten equipment to walls or other structural surfaces on which they are mounted. Provide independent galvanized steel supports where no wall or other structural surface exists

C. Temporary lifting provisions: remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install in conformance with National Electrical Code.

3.03 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26.

B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

C. For double throw switches identify source of each service identify source of each service.

3.04 CONNECTIONS

A. Install equipment grounding connections for switches and circuit breakers with ground continuity to main electrical ground bus.

B. Install power wiring. Install wiring between switches and circuit breakers, and control and indication devices.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.05 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements. Comply with applicable reference standards listed in Article 1.03.

B. Testing: After installing enclosed switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

C. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.

D. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.06 CLEANING

A. On completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.07 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 26 29 13

ENCLOSED CONTROLLERS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide general-purpose controllers and motor starters rated 600 V and less that are supplied as enclosed units in accordance with this Section and applicable reference standards listed in Article 1.03.

B. Related Requirements

1. Section 26 05 00 – Common Work Results for Electrical

2. Section 26 05 26 – Grounding and Bonding for Electrical Systems

3. Section 26 05 33 – Raceways and Boxes for Electrical Systems

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. National Fire Protection Association (NFPA)

a. NFPA 70 National Electrical Code

2. Underwriters Laboratories (UL)

a. UL 508 Industrial Control Equipment

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

B. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

D. Coordinate features of enclosed controllers and accessory devices with pilot devices and control circuits to which they connect.

E. Coordinate features, accessories, and functions of each enclosed controller with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data: For each type of enclosed controller. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.

C. Shop Drawings: For each enclosed controller.

1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Enclosure types and details.

b. Nameplate legends.

c. Short-circuit current rating of integrated unit.

d. UL listing for series rating of over-current protective devices in combination controllers.

e. Features, characteristics, ratings, and factory settings of individual over-current protective devices in combination controllers.

f. Listing of the motor starters to be furnished with their location and equipment to be controlled and identified

2. Wiring diagrams: power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.

D. Load-current and overload-relay heater list: compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

E. Closeout and maintenance material submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Manufacturer qualifications: maintain, within 100 miles (160 km) of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

C. Source limitations: obtain enclosed controllers of a single type through one source from a single manufacturer.

D. Electrical components, devices, and accessories: listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NEMA Standard ICS2 110, General Standards for Manual and Magnetic Controllers.

F. Comply with NEMA Standard ICS2 321 AC General Purpose Class A Controller for Squirrel Cage Induction Motors, 600 volts and less.

G. UL 508, Industrial Control Equipment.

H. Comply with NFPA 70.

I. Product selection for restricted space: Drawings indicate maximum dimensions for enclosed controllers, including clearances between enclosed controllers, and for adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

C. If stored in areas subjected to weather, cover enclosed controllers to protect from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

1.09 MAINTENANCE

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish 1 spare fuse for every 5 installed, but not less than 1 set of 3 of each type and rating.

2. Indicating lights: 2 of each type installed.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Manual and Magnetic Enclosed Controllers

1. Square D by Schneider Electric

2. ABB

3. Eaton/Cutler-Hammer

4. ABB

5. Rockwell Automation/Allen-Bradley

6. Or equal

2.02 ACCESSORIES

A. Devices to be factory installed in controller enclosure, unless otherwise indicated.

B. Push-button stations, pilot lights, and selector switches: NEMA ICS 2, heavy-duty type.

C. Stop and lockout push-button station: momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

D. Hand-off –automatic three position selector switch.

E. Control relays: auxiliary and adjustable time-delay relays.

2.03 FACTORY FINISHES

A. Manufacturer's standard prime coat finish ready for field painting.

B. Finish: manufacturer's standard grey paint applied to factory-assembled and -tested enclosed controllers before shipping.

2.04 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine areas and surfaces to receive enclosed controllers for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

A. Select features of each enclosed controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, drive, and load; and configuration of pilot device and control circuit affecting controller functions.

B. Select horsepower rating of controllers to suit motor controlled.

3.03 INSTALLATION

A. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks as required.

B. Mount equipment so that sufficient access and working space is provided for ready and safe operation and maintenance.

C. Securely fasten equipment to walls or other surfaces on which they are mounted. Provide independent galvanized steel supports reasonably close to motor where no wall or other surface exists.

3.04 IDENTIFICATION

A. Identify enclosed controller components and control wiring according to Division 26 requirements.

3.05 CONTROL WIRING INSTALLATION

A. Install wiring between enclosed controllers according to Division 26 requirements.

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic-control devices where applicable.

1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.

2. Connect selector switches with enclosed controller circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.06 CONNECTIONS

A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Ground equipment.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.07 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

B. Testing: Perform the following field quality-control testing:

1. Perform each electrical test and visual and mechanical inspection indicated in NETA ATS, Sections 7.5, 7.6, and 7.16.

2. Certify compliance with test parameters.

3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Test Reports: Prepare a written report to record the following:

1. Test procedures used.

2. Test results that comply with requirements.

3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

3.08 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.09 CLEANING

A. Clean enclosed controllers internally, on completion of installation, according to manufacturer's written instructions. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.10 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

B. Verify that enclosed controllers are installed and connected according to the Contract Documents.

C. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 26 Sections.

D. Complete installation and startup checks according to manufacturer's written instructions.

3.11 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 26 29 23

VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide variable frequency drives in accordance with this Section and applicable reference standards listed in Article 1.03.

2. Provide field programming and testing of each VFD. Program each VFD based on the actual motor sizes and ratings in the field. Provide adjustments to VFD parameters to account for European motors (if necessary).

B. Related Requirements

1. Section 26 05 00 - Common Work Results for Electrical

2. Section 26 05 26 - Grounding and Bonding for Electrical Systems

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. National Electrical Code (NEC)

a. Article 430 Motors, Motor Circuits and Controllers

2. National Electrical Contractors Association (NECA)

a. National Electrical Installation Standards (NEIS)

3. National Electrical Manufacturers Association (NEMA)

a. NEMA ICS 2 Controllers, Contactors and Overload Relays Rated 600 V

b. NEMA ICS 6 Industrial Controls and Systems: Enclosures

c. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum)

4. Underwriter's Laboratory (UL)

   a. UL 486A-486B Wire Connectors

   b. UL 489 Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Provide in accordance with Division 01 General Requirements.

B. Furnish manufacturer's product data, test reports, and materials certifications as required.

C. Product Data: manufacturer's data and installation instructions.

D. Layout Drawings showing accurate scaled basic equipment sections, dimensions, and internal devices.

E. Wiring diagrams: power and control wiring diagrams for connections to electrical power panels, feeders, and equipment. Differentiate between portions of wiring which are manufacturer installed and portions, which are field installed.

F. Motor overload sizes for each new VFD furnished. Overload size shall be based on actual motor nameplate data and power factor correction size; where applicable. Include thermal overload compensation sizing information where motors are operated at temperatures different than the motor controller.

G. Closeout and maintenance material submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Qualifications: per Division 01 General Requirements and as follows.

1. Firms regularly engaged in manufacture of variable frequency drives of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years, or as specified.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 VARIABLE FREQUENCY DRIVES (VFD)

A. Manufacturers

1. Rockwell Automation/Allen Bradley
2. Square D
3. Eaton/Cutler Hammer
4. Or equal

B. VFD to convert the input AC main power to an adjustable frequency and voltage as defined in the following sections. VFD to be UL listed and labeled as a complete unit, and include all accessories and requirements as specified and identified on the Drawings.

C. VFD to be phase converting 240V single phase input and three phase 240V output.

D. Each drive to have a rating horsepower (HP) equal to or greater than the motor name plate horsepower and each drive to have a continuous output current rating equal to or greater than the motor full load amperes (FLA).

E. Input Power

1. The drive is available ranges and is self-adjustable to accept an input voltage range between; 216-264 V AC, single phase +/-10% AC.
2. Displacement power factor 0.98, lagging, over the entire speed range. The efficiency of the drive is a minimum of 97.5% at full load and speed.

F. Environment

1. Storage ambient temperature range: -40º C to 60º C (-40º to 140ºF).
2. Operating ambient temperature range without derating: IP21 / Type 10º C to 40º C (0º to 104º F).
3. The relative humidity range is 5% to 95% non-condensing.
4. Operating elevation: up to 1000 Meters (3,300ft) without derating.

5. Shock: 15G peak for 11ms duration

6. Vibration: 2.0 mm (0.0787 inches) displacement, 1G peak, EN50178 / EN60068-2-6

G. Output Power

1. The output voltage is adjustable from 0 to rated motor voltage (240 V, 400 V, 460 V, 575 V or 690 V). The output frequency range is adjustable from 0 to 320Hz. The inverter section will produce a pulse width modulated (PWM) waveform using latest generation IGBTs.

H. Motor and Application Data

1. AC drives to have the ability to operate variable or constant torque loads. The speed range shall be from a minimum speed of 1.0 Hz to a maximum speed of 60 Hz. The normal duty drive overload current shall be 100% continuous, 110 percent for 1 minute, and 150 percent for 3 seconds. The heavy duty drive overload current shall be 100 percent continuous, 150 percent for 1 minute, and 200 percent for 3 seconds.

Equipment	HP	Voltage	Application	Duty Type
Pump No.1	5	240/3PH	Variable Torque	Heavy
Pump No.2	5	240/3PH	Variable Torque	Heavy

I. Hardware

1. The drive hardware employs the following power components:

a. Diode or fully gated bridge on the input.

b. AC line reactor on input for all ratings.

c. Switching logic power supply operating from the DC bus.

d. MOV protection available on Frame 9 only - phase to phase and phase to ground with ability to remove the phase to ground unit when applicable.

e. Common mode capacitors available on all units. For use on ungrounded systems Frame 9 is orderable without and Frame 10 and higher removable by jumper.

f. Gold plated plug-in connections on printed circuit boards.

g. Microprocessor based inverter logic isolated from power circuits.

h. Latest generation IGBT inverter section.

i. Customer Interface common for all horsepower ratings. LCD digital display standard with choices for programming keypad and operator keys options.

j. The Main Control Board is the same for all ratings to optimize spare parts stocking and exchange.

k. Common control connection for all ratings.

l. Optimized for 2kHz carrier frequency.

m. Device Peripheral Interface (DPI) for connection to common options.

n. Power LED viewable through the control box cover.

o. Status LEDs for communications status, including embedded DPI status, adapter health and communications network status, viewable at HIM mounting plate.

J. Control Logic

1. The drive is programmable or self-adjusting for the following:

a. Operating the drive with motor disconnected.

b. Controlled shut down, when properly fused, with no component failure in the event of an output phase to phase or phase to ground short circuit and annunciation of the fault condition.

c. Adjustable PWM carrier frequency within a range of 1-6 kHz.

d. Selectable Sensorless Vector or V/Hz mode.

e. Suitable for use on both Normal Duty and Heavy Duty loads.

f. Multiple programmable stop modes including - Ramp, Coast, DC-Brake, Ramp-to-Hold and S-curve.

g. Multiple acceleration and deceleration rates.

h. All adjustments to be made with the door closed.

i. Adjustable output frequency up to 320Hz.

K. Terminal Blocks

1. Separate terminal blocks are provided for control and power wiring. Power terminal blocks are rated a minimum of 90 degrees C and marked for both inputs and outputs (L1, L2, L3 and U/T1, V/T2, W/T3).

L. Power Conditioning

1. The drive is designed to operate on an AC supply source that may contain line notching and up to 10 percent harmonic distortion. An input isolation transformer is not required for protection from normal line transients. If line conditions dictate the use of a transformer, the K factor should be 4.0 or less.

M. Operator Interface

1. Interface to the drive is provided via a removable Human Interface Module (HIM) with integral display. This unit is a 7 line by 21-character backlit LCD display with graphics capability. It is used to display drive operating conditions, fault/alarm indications and programming information with full text support in multiple languages, including but not limited to English, German, French, Italian, Spanish, Portuguese and Dutch.

2. The keypads for these include programming keys, drive operating keys (Start, Stop, Direction, Jog and Speed Control), numeric keys for direct entry and an ALT (alternate function) key to allow some of the more common drive programming or operating functions to be accessed directly without knowledge of programming structure. These ALT functions include S.M.A.R.T. Start for fast and easy commissioning, View selection, Auto Manual operation, HIM removal under power, and device selection for programming.

N. Input/Output Capabilities (Control Interface):

1. Analog Inputs/Outputs

a. Two differential, +/-10V (bi-polar) / 20mA analog inputs, 11 bit plus sign, 160V common mode noise rejection. Both inputs shall be fully user programmable for a variety of uses including frequency command, process loop inputs, and others. Inputs are programmable for function, scaling, offset, signal loss detect and square root.

b. Two single-ended +/-10V (bi-polar) / 20mA analog output, 11 bit plus sign. Both to be fully user programmable to be proportional to one of 25 process parameters including output frequency, output current, encoder feedback, output power, and others. Programming is available to select either absolute or signed values of these parameters.

c. Input for motor protection thermistor (1.8k Ohm PTC). Drive will provide fault protection if temperature exceeds protection value.

2. Digital Inputs/Outputs

a. Six digital inputs 24Vdc or 120Vac as shown. Inputs shall be configurable as sink or source. All inputs are individually programmable for functions from a list of 57 that include Start(3-wire control, Run(2-wire control), Stop, External fault, Speed select, Jog, Process PU functions, Level-sensitive Run, and others. 24V inputs draw 10mA each and require a 20V minimum for "ON" state and a maximum for 5V "OFF" state. 115Vac inputs draw 5mA each and require a 100V minimum for "ON" state and a maximum of 30V for "OFF" state.

b. One input shall able to be set by a jumper to be a Hardware Enable. In this state, no microprocessor control is involved with disabling the drive outputs.

c. Three relay outputs, (1 form-C, 1 form-B, 1 form-A). Contact output ratings 240Vac/30Vdc and require a 10mA minimum clearing current. Relays are programmable to 57 different conditions. Outputs to have timers that control the amount of time before an output changes state. All outputs shall have an on-delay and off-delay timers relative to the function assigned to the input.

O. Features

1. Acceleration/Deceleration: settings provide separate adjustments to allow either setting to be adjusted from 0.0 seconds to 3276.7 seconds. A second set of remotely selectable Accel/Decel settings is accessible through digital inputs. Programming capability allows the user to produce acc/dec profiles with linear or "S-Curve" characteristics that provide changing accel/decel rates. S-Curve profiles are adjustable.

2. Adjustments: digital interface is used for all set-up, operation and adjustment settings. All adjustments are stored in nonvolatile memory (EEPROM). No potentiometer adjustments are used. The drive provides EEPROM memory for factory default values and user stored drive configurations.

3. Auto economizer: automatically reduces the output voltage when the drive is operating in an idle mode (drive output current less than programmed motor FLA). The voltage is reduced to minimize flux current in a lightly loaded motor thus reducing kW usage. If the load increases, the drive will automatically return to normal operation.

4. Auto / Manual Mode: the HIM can utilize the ALT function key to transfer the drive from Automatic mode to Manual mode and back. When in Auto mode, the drive receives its frequency command from the programmed source. When in Manual mode, control of the frequency command is transferred to the HIM speed control keys (or potentiometer). The user has the choice of preloading the HIM with the current "auto" frequency reference before transferring control to allow for smooth transitions without speed "jumps".

5. Auto restart: drive provides up to nine automatic fault reset and restarts following a fault condition before locking out and requiring manual restart. The automatic mode is not applicable to a ground fault, shorted output faults and other internal microprocessor faults. The time between restarts is adjustable from 0.5 seconds to 30.0 seconds.

6. Bus regulation: DC Bus regulation is available to reduce the possibility of drive overvoltage trips due to regenerative conditions. The drive's reaction to a Bus voltage increase is programmable to one of 4 options.

7. Communications interface: drive has the capability for either internally mounted or externally mounted communications interface cards. Internal cards use drive power and can operate at higher speeds. Externally mounted cards are separately powered and connected to the drive via a cable. The following should be available:

    a. Ethernet communications to be available.

8. Control mode: programming provides the ability to select either Sensorless Vector or V / Hz mode. The sensorless vector mode uses motor nameplate data plus motor operating data such as IR drop, nominal flux current and flux up time to tune the motor / drive for optimum torque performance. The volts per hertz mode can be programmed straight line, preprogrammed fan curve or full custom patterns.

9. Current limit: programmable current limit from .1 amps to 150% of drive rated amps. Current limit is active for all drive states; accelerating, constant speed and decelerating. Both the source of the current limit value and the gain for responsiveness adjustment are programmable. The drive employs PI regulation with an adjustable gain for smooth transition in and out of current limit.

10. Fault memory: the last eight fault codes with respective times are stored in the fault buffer. In addition, information about the drive's condition at the time of the last fault such as operating frequency, output current, dc bus voltage and 28 other status conditions are stored at the time of fault. Information is maintained in the event of a power loss. A power up marker is also provided at each power up time to aid in analyzing fault data. The last eight alarm codes are also stored, without time stamp for additional troubleshooting reference.

    a. If the VFD has provisions available to accommodate an integral battery to store time/date settings through power cycles, then a battery shall be provided to store time/dates and help troubleshoot drive-level faults and alarms.

11. Flying start: drive is capable of determining the speed and direction of a spinning motor and adjusts its output to "pick-up" the motor at the rotating speed.

12. Inertia ride through: drive can respond to a loss of AC input power by adjusting the output frequency to create a regenerative situation in the motor. This regenerated energy recaptures the mechanical energy and converts it to electrical energy to power the drive logic during the power outage. This allows the drive to retain control of the motor during the power outage. Performance is based on the amount of system inertia and the length of the outage. The bus voltage level required to trigger inertia ride through is adjustable. Inertia Ride Through can be enabled or disable via programming.

13. Memory storage: drive stores the factory default settings in non-volatile memory (EEPROM) so that the user can return the drive to a known state. Additional memory storage locations in the drive, known as user sets can also be stored in the drive's non-volatile memory. Three User Set locations are offered. The user can name the sets per the process application and recall the configuration to active drive memory as needed.

14. Motor overload protection: drive will provide Class 10 motor overload protection investigated by UL to comply with NEC. Article 430. Overload protection is speed sensitive and adjustable. To accommodate a variety of motors with different speed range capabilities, the frequency at which the overload begins to derate is programmable. A parameter is available to directly read the level of accumulated overload.

15. Ride through: control logic is capable of "riding through" a power outage of at least 2 seconds in duration. The inverter section is shut off after an 28 percent drop in bus voltage to conserve power for the drive logic. The ride through method and trigger point are adjustable by the user.

16. Process PI control: the internal process PI regulator has proportional and integral gain adjustments as well as error inversion and output clamping functions. The feedback can be configured for normal or square root functions. If the feedback indicates that the process is moving away from the setpoint, the regulator will adjust the drive output until the feedback equals the reference. Process control can be enabled or disabled with a hardwired input. Transitioning in and out of process control can be tuned for faster response by preloading the integrator. Protection is provided for a loss of feedback or reference signal. A signal can also be provided to indicate that excess error exists.

P. VFD Enclosures

1. VFDs shall be provided integral to the facility MCCs as indicated on the Drawings and as specified in 26 24 19, Motor-Control Centers.

2. Where stand-alone/enclosed drives are required or specified, the following requirements shall be met.

a. Unit shall be wall or floor mountable and be NEMA type 12 rated. Provide with integral cooling equipment and adjustable temperature controls to maintain operational conditions per manufacturers requirements.

b. Unit shall be provided with lockable Main Circuit Breaker.

c. The enclosures shall be provided with an input Line Reactor with an Impedance rating of 3% or 5% as indicated on the Drawings for voltage transient protection, and for a degree of protection from harmonic distortion.

d. Provide with door mounted HAND/OFF/REMOTE selector switch.

1) HAND Mode: a local start control via door mounted Operator Interface.

2) REMOTE Mode: start control provided via a remote contact in the SCADA control panel. Provide an extra set of contacts on the selector switch to monitor switch position via the facilities SCADA control panel.

e. Provide door mounted 120VAC push-to-test LED pilot lights for ON red and OFF green indication. Provide additional LED pilot lights as indicated on the Drawings.

f. Provide door mounted human machine interface (HMI) module or keypad for programming, display and control. The unit shall be a 7 line by 21-character backlit LCD display with graphics capability. The display shall be utilized to display the VFD operating conditions, fault/alarm indications, programming, and speed control with full text support.

g. Where indicated on the Drawings, VFD enclosures shall be designed to accommodate Motor High Temp and Seal Monitoring Controllers/Relays as required by the submersible pump manufacturer. Controllers/Relays shall be furnished by the pump vendor and field installed by the Contactor as shown on the Drawings. MCC manufacturer shall coordinate with selected pump vendors to verify Controller/Relay wiring and installation requirements.

2.02 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Examine areas and conditions under which VFDs are to be installed and notify the Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

B. Per NEMA ICS 3.1, install equipment in accordance with the approved manufacturer's printed installation drawings, instructions, wiring diagrams, and as indicated on project drawings and the approved shop drawings. A field representative of the VFD manufacturer shall supervise the installation of all equipment, and wiring.

C. Certified factory start-up shall be provided for each VFD provided. Service Engineers shall be employed by the manufacturer or be certified by the manufacturer and provide start-up services including physical inspection of drive and connected wiring and final adjustments to meet specified performance requirements.

D. Make equipment grounding connections for each VFD in accordance with all applicable codes and as recommended by the manufacturer.

E. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers' published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and B, and the MEC.

F. Wall-mount the enclosures using spacers or standoffs (1/4 inch minimum).

3.02 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

B. Prior to energizing motor controller equipment, check with ground resistance tester, phase to phase and phase to ground insulation resistance levels to ensure requirements are fulfilled.

C. Prior to energizing, check circuitry for electrical continuity, and for short circuits.

3.03 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.04 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 26 32 13.13

DIESEL-ENGINE-DRIVEN GENERATOR SETS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide a generator set in accordance with this Section and applicable reference standards listed in Article 1.03.

2. Provide automatic transfer switch with this Section and applicable reference standards listed in Article 1. 03.

B. Related Requirements

1. Section 26 05 00 - Common Work Results for Electrical

2. Section 26 05 33 - Raceways and Boxes for Electrical Systems

3. Section 26 05 26 - Grounding and Bonding for Electrical Systems

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. Institute of Electrical and Electronics Engineers (IEEE)

a. IEEE 241 IEEE recommended practice for electrical power systems in commercial buildings

b. IEEE C37.90.1: Ringing wave immunity

c. IEEE 446 IEEE recommended practice for emergency and standby power systems

d. IEEE-693 IEEE Recommended Practice for Seismic Design of Substations

2. International Organization for Standardization (ISO)

a. ISO 8528 Reciprocating Internal Combustion Engine Driven Alternating Current Generating Sets

3. National Electrical Manufacturers Association (NEMA)

   a. NEMA ICS10: AC automatic transfer switch equipment (supersedes ICS2-447)

   b. NEMA ICS 6: Industrial Control and Systems: Enclosures

   c. NEMA 250: Enclosures

4. National Fire Protection Association (NFPA)

   a. NFPA 70 National Electrical Code

   b. NFPA 99 Essential electrical systems for health care facilities

   c. NFPA 101 Life safety code

   d. NFPA 110 Standard for emergency and standby power systems

5. Underwriters Laboratories (UL)

   a. UL50 Enclosures for Electrical Equipment, Non-Environmental Considerations

   b. UL 508 Enclosures

   c. UL142 Aboveground Flammable Liquid Tanks

   d. UL 1008 Standard for Automatic Transfer Switches

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Engine-generator submittals shall include the following information:

1. Factory published specification sheet.

2. Manufacturer's catalog cut sheets of all auxiliary components such as battery charger, control panel, enclosure, fuel system filter, etc.

3. Dimensional elevation and layout drawings of the generator set, enclosure and transfer switchgear and related accessories

4. Weights of all equipment.

5. Concrete pad recommendation, layout and stub-up locations of electrical and fuel systems.

6. Interconnect wiring diagram of complete emergency system, including generator, switchgear, battery charger, control panel, and remote alarm indications.

7. Engine mechanical data, including heat rejection, exhaust gas flows, combustion air and ventilation air flows, fuel consumption, etc.

8. Generator electrical data including temperature and insulation data, cooling requirements, excitation ratings, voltage regulation, voltage regulator, efficiencies, waveform distortion, and telephone influence factor.

9. Generator resistances, reactance's and time constants.

10. Generator locked rotor motor starting curves.

11. Manufacturer's documentation showing maximum expected transient voltage and frequency dips, and recovery time during operation of the generator set at the specified site conditions with the specified loads.

12. Manufacturer's and dealer's written warranty.

C. Closeout and maintenance material submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

1.09 MAINTENANCE

A. Service Facility

1. The engine-generator supplier shall maintain 24-hour parts and service capability within 100 miles of the project site. The distributor shall stock parts as needed to support the generator set package for this specific project. The supplier must carry sufficient inventory to cover no less than 80 percent parts service within 24hrs and 95 percent within 48 hours.

B. Service Personnel

1. The dealer shall maintain qualified factory trained service personnel.

C. Product Support

1. Total Maintenance and Repair Agreement

a. The authorized manufacturer's dealer shall provide pricing for an optional total maintenance and repair agreement using qualified factory trained service personnel for a period of 5 years minimum. The dealer shall provide genuine Manufacturer parts and filters, shall provide all recommended fluids, dealer labor, travel labor and travel mileage to complete the suggested preventive maintenance and overhauls as defined in the manufacturer's Operation and Maintenance Manual. The dealer shall also provide all genuine Manufacturer parts and filters, recommended fluids, dealer labor, travel labor and travel mileage to complete all unscheduled repairs and component replacements during the agreement period.

1.10 WARRANTY

A. Two Year Standby (ISO 8528-1: ESP) Generator Set Warranty

1. Manufacturer's standard warranty for a period of 2 years from date of initial start-up of the system and shall include repair parts, labor, reasonable travel expense necessary for repairs at the job site, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by the defect) used during the course of repair. Running hours shall be limited to 500 hours annually for the system warranty by both the manufacturer and servicing distributor.

2. Automatic transfer switch to be warranted against defective workmanship for a period of 2 years, including both parts and labor.

PART 2 – PRODUCTS

2.01 SYSTEM RESPONSIBILITY

A. Generator Set Distributor

1. Completed engine generator set to be supplied by manufacturer's authorized distributor only.

B. Requirements, Codes, and Regulations

1. Equipment supplied and installed to meet NEC requirements and all-applicable local codes and regulations. There is to be one source responsibility for warranty; parts and service through a local representative with factory trained service personnel.

C. Automatic Transfer System

1. Automatic transfer switch shall be supplied by the generator set manufacturer in order to establish and maintain a single source of system responsibility and coordination.

2.02 WORK INCLUDED

A. Installation

1. The Work includes furnishing and installing a complete integrated generator system. The system consists of a diesel generator set with related component accessories, and automatic transfer switch.

B. Fuel System

1. Provide a full tank of diesel fuel for the completion of all testing as specified.

C. System Test

1. A complete system load test shall be performed after all equipment is installed. Guidelines in the Start-up Section.

D. Requirements, Codes and Regulations

1. The equipment supplied and installed to meet NEC requirements and codes and regulations. All equipment shall be of new and current production by a Manufacturer who has 25 years of experience building this type of equipment. Manufacturer shall be ISO9001 certified.

2. Each Generator Set and ATS shall be Seismic Certified.

2.03 MANUFACTURERS

A. Caterpillar

B. Cummins Power Generation

C. Kohler

D. Or equal

2.04 GENERAL REQUIREMENTS

A. Genset Requirements

1. The generator set shall be Standby Duty rated at 50kW, 50kVA, 208.33Amps 1800RPM, 0.8 power factor, 120/240V, 1-Phase, 60Hz, including radiator fan and all parasitic loads. Generator set shall be sized to operate at the specified load at a maximum ambient of 77ºF (25ºC) and altitude of 500 feet (152.4m). The engine generator set shall be capable of reliably starting the connected loads in the order listed in the table below. This shall be accomplished without exceeding the voltage and frequency specifications listed below:

Maximum Allowable Starting Voltage Dip	Maximum Allowable Peak Voltage Dip	Maximum Allowable Frequency Dip
20%	**20%**	**20%**

Load Name	**Load Rating (HP/kVA)**	**Starting Method**
Step 1:		
Panel LP Misc Load	11kVA	General Loads
Step 2:		
Pump No.1	5hp	VFD PWM
Step 3:		
Pump No.2	5hp	VFD PWM

2. Standby Power Rating:

   a. Power is available for the duration of an emergency outage

   b. Average Power Output = 70 percent of standby power

   c. Load = Varying

   d. Typical Hours/Year = 200 Hours

   e. Maximum Expected Usage = 500 hours/year

   f. Typical Application = Standby

B. Material and Parts

1. All materials and parts comprising the unit shall be new and unused.

C. Engine

1. The engine shall be diesel fueled, four (4) cycle, water-cooled, while operating with nominal speed not exceeding 1800RPM. The engine will utilize in-cylinder combustion technology, as required, to meet applicable EPA non-road mobile regulations and/or the EPA NSPS rule for stationary reciprocating compression ignition engines. Additionally, the engine shall comply with the State Emission regulations at the time of installation/commissioning. Actual engine emissions values must be in compliance with applicable EPA emissions standards per ISO 8178 – D2 Emissions Cycle at specified ekW/bHP rating. Utilization of the "Transition Program for Equipment Manufacturers" (also known as "Flex Credits") to achieve EPA certification is not acceptable. The in-cylinder engine technology must not permit unfiltered exhaust gas to be introduced into the combustion cylinder.

2. Engine Governing

a. The engine governor shall be an electronic Engine Control Module (ECM) with 24-volt DC Electric Actuator. The ECM shall be enclosed in an environmentally sealed, die-cast aluminum housing which isolates and protects electronic components from moisture and dirt contamination. Speed droop shall be adjustable from 0 (isochronous) to 10 percent, from no load to full rated load. Steady state frequency regulation shall be +/- 6RPM. Speed shall be sensed by a magnetic pickup off the engine flywheel ring gear. A provision for remote speed adjustment shall be included. The ECM shall adjust fuel delivery according to exhaust smoke, altitude and cold mode limits. In the event of a DC power loss, the forward acting actuator will move to the minimum fuel position.

2.05 GENERATOR

A. Generator Specifications

1. The synchronous three phase generator shall be a single bearing, self-ventilated, drip-proof design in accordance with NEMA MG 1 and directly connected to the engine flywheel housing with a flex coupling. The generator shall meet performance class G2 of ISO 8528. The excitation system shall enable the alternator to sustain 300 percent (250 percent for 50Hz) of rated current based on the 125C (Class H) or 105C (Class F) rise rating for ten seconds during a fault condition and shall improve the immunity of the voltage regulator to non-linear distorting loads. The excitation system shall be of brushless construction and be independent of main stator windings (either permanent magnet or auxiliary windings).

B. Voltage Regulator

1. Digital Voltage Regulator

a. The digital voltage regulator shall be microprocessor based with fully programmable operating and protection characteristics. The regulator shall maintain generator output voltage within +/- 0.25 percent for any constant load between no load and full load. The regulator shall be capable of sensing true RMS in three phases of alternator output voltage, or operating in single phase sensing mode. The voltage regulator shall include a VAR/Pf control feature as standard. The regulator shall provide an adjustable dual slope regulation characteristic in order to optimize voltage and frequency response for site conditions. The voltage regulator shall include standard the capability to provide generator paralleling with reactive droop compensation and reactive differential compensation.

b. The voltage regulator shall communicate with the Generator Control Panel via a J1939 communication network with generator voltage adjustments made via the controller keypad. Additionally, the controller shall allow system parameter setup and monitoring, and provide fault alarm and shutdown information through the controller. A PC-based user interface shall be available to allow viewing and modifying operating parameters in a windows compatible environment

2.06 CIRCUIT BREAKER

A. Circuit Breaker Specifications

1. Provide a generator mounted 100 percent rated circuit breaker, molded case, manually operated with 200 amp trip, 2 pole, NEMA 1/IP22. Breaker shall utilize a solid state microelectronic trip unit, with adjustable LSIG functions. The breaker shall be UL listed, connected to engine/generator safety shutdowns. Breaker shall be housed in an extension terminal box which is isolated from vibrations induced by the generator set. Mechanical type lugs, sized for the circuit breaker feeders shown on drawing, shall be provided by the installation contractor.

2.07 CONTROLS - GENERATOR SET MOUNTED

A. Provide a fully solid-state, microprocessor based, generator set control. The control panel shall be designed and built by the engine manufacturer. The control shall provide all operating, monitoring, and control functions for the generator set. The control panel shall provide real time digital communications to all engine and regulator controls via SAE J1939,

B. Environmental

1. The generator set control to be tested and certified to the following environmental conditions:

a. –40°C to +70°C Operating Range

b. 20°C to +55°C at 95% humidity for 48 hours

c. IP22 protection for rear of controller; IP42 when installed in control panel

d. Sinusoidal vibration 10 sweeps in 3 major axis: 5 to 8Hz @ +/- 7.5mm, 5 to 500Hz @ 2G

e. Electromagnetic Capability (89/336/EEC, 91/368/EEC, 93/44/EEC, 93/68/EEC, BS EN 50081-2, 50082-2, BS EN 61000-6-2, BS EN 61000-6-4)

f. Shock: withstand 15G for 11ms

C. Functional Requirements

1. The following functionality shall be integral to the control panel:

a. The control shall include an LCD display

b. The control shall include a minimum of 6-line data display

c. Audible horn for alarm and shutdown with horn silence switch

d. Standard ISO labeling

e. Multiple language capability

f. Remote start/stop control

g. Local run/off/auto control integral to system microprocessor

h. Cooldown timer

i. Speed adjust

j. Lamp test

k. Emergency stop push button

l. Password protected system programming

D. Digital Monitoring Capability

1. The controls shall provide the following digital readouts for the engine and generator. All readings shall be indicated in either metric or English units.

a. Engine

1) Engine oil pressure

2) Engine oil temperature

3) Engine coolant temperature

4) Engine RPM

5) Battery volts

6) Engine hours

7) Engine crank attempt counter

8) Engine successful start counter

9) Service maintenance interval

10) Real time clock

11) Engine exhaust stack temperature

12) Engine main bearing temperature

b. Generator

1) Generator AC volts (Line to Line, Line to Neutral, and Average)

2) Generator AC current (Average and Per Phase)

3) Generator AC Frequency

4) Generator kW (Total and Per Phase)

5) Generator kVA (Total and Per Phase)

6) Generator kVAR (Total and Per Phase)

7) Power Factor (Avg and Per Phase)

8) Total kW-hr

9) Total kVAR-hr

10) % kW

11) % kVA

12) % kVAR

E. Alarms and Shutdowns

1. The control shall monitor and provide alarm indication and subsequent shutdown for the following conditions. All alarms and shutdowns are accompanied by a time, date, and engine hour stamp that is stored by the control panel for first and last occurrence.

2. Engine Alarm/Shutdown

a. Low oil pressure alarm/shutdown

b. High coolant temperature alarm/shutdown

c. Loss of coolant shutdown

d. Overspeed shutdown

e. Overcrank shutdown

f. Emergency stop shutdown

g. Low coolant temperature alarm

h. Low battery voltage alarm

i. High battery voltage alarm

j. Control switch not in AUTO position alarm

k. Battery charger failure alarm

3. Generator Alarm/Shutdown

a. Generator phase sequence

b. Generator over voltage

c. Generator under voltage

d. Generator over frequency

e. Generator under frequency

f. Generator reverse power (real and reactive)

g. Generator overcurrent

4. Voltage Regulator Alarm/Shutdown

a. Loss of excitation alarm/shutdown

b. Instantaneous over excitation alarm/shutdown

c. Time over excitation alarm/shutdown

d. Rotating diode failure

e. Loss of sensing

f. Loss of PMG

F. Inputs and Outputs

1. Programmable Digital Inputs

a. Controller to include the ability to accept 8 total with 6 programmable digital input signals. The signals may be programmed for either high or low activation using programmable Normally Open or Normally Closed contacts.

2. Programmable Relay Outputs

a. The control shall include the ability to operate eight (8) discrete outputs, integral to the controller, 2 which are rated at 5A continuous, 6 rated 2A continuous.

G. Maintenance

1. All engine, voltage regulator, control panel, and accessory units shall be accessible through a single electronic service tool. The following maintenance functionality shall be integral to the generator set control:

a. Engine running hours display

b. Service maintenance interval (running hours or calendar days)

c. Engine crank attempt counter

d. Engine successful starts counter

e. 250 events are stored in control panel memory

f. Programmable cycle timer that starts and runs the generator for a predetermined time. The timer shall use 7 user-programmable sequences that are repeated in a 7-day cycle. Each sequence shall have the following programmable set points:

1) Day of week

2) Time of day to start

3) Duration of cycle

4) The scheduler can start, stop or inhibit the genset from starting at predetermined time. Up to eight (8) sequences can be configured to repeat in 7 day or 28 day cycle.

H. Remote Communications

1. The control panel shall include Modbus TCP communications via Ethernet 10BASE-T and Modbus RTU communications via RS-485 half duplex with configurable baud rates from 2.4k to 57.6k.

I. Annunciation

1. Local Annunciator (NFPA 99/110, CSA 282)

2. Provide a local, control panel mounted, annunciator to meet the requirements of NFPA 110, Level 1.

a. Annunciators shall be networked directly to the generator set control.

b. Local Annunciator shall include a lamp test pushbutton, alarm horn and alarm acknowledge pushbutton.

c. Provide the following individual light indications for protection and diagnostics:

1) Overcrank

2) Low coolant temperature

3) High coolant temperature warning

4) High coolant temperature shutdown

5) Low oil pressure warning

6) Low oil pressure shutdown

7) Overspeed

8) Low coolant level

9) EPS supplying load

10) Control switch not in auto

11) High battery voltage

12) Low battery voltage

13) Battery charger AC failure

14) Emergency stop

15) Spare (or ATS Remote Start wiring failure)

16) Spare (or Tier 4 SCR when applicable)

2.08 COOLING SYSTEM

A. The generator set shall be equipped with a rail-mounted, engine-driven radiator with blower fan and all accessories. The cooling system shall be sized to operate at full load conditions and 110ºF ambient air entering the room or enclosure (If an enclosure is specified). The generator set supplier is responsible for providing a properly sized cooling system based on the enclosure static pressure restriction.

2.09 FUEL SYSTEM

A. Fuel System

1. The fuel system shall be integral with the engine. In addition to the standard fuel filters provided by the engine manufacturer, there shall also be installed a primary fuel filter/water separator in the fuel inlet line to the engine. All fuel piping shall be black iron or flexible fuel hose rated for this service. No galvanized piping will be permitted. Flexible fuel lines shall be minimally rated for 300 °F and 100psi.

B. Fuel Sub Base Tank

1. Provide a double wall sub-base tank constructed to meet all local codes and requirements. A fuel tank base of 48 hour capacity shall be provided as an integral part of the enclosure. It shall be contained in a rupture basin with 110 percent capacity. The tank shall meet UL 142. A locking fill cap, a mechanical reading fuel level gauge, low fuel level alarm contact, and fuel tank rupture alarm contact shall be provided.

2.10 EXHAUST SYSTEM

A. Silencer

1. A critical grade silencer, companion flanges, and flexible stainless steel exhaust fitting properly sized shall be furnished and installed according to the manufacturer's recommendation. Provide mounting as shown on the Drawings. Mount silencer so its weight is not supported by the engine nor will exhaust system growth due to thermal expansion be imposed on the engine. Exhaust pipe size to be sufficient to ensure that exhaust backpressure does not exceed the maximum limitations specified by the engine manufacturer.

2. The complete exhaust system shall be internal to the sound attenuated enclosure. Units with roof mounted or externally exposed silencers are not acceptable.

2.11 STARTING SYSTEM

A. Starting Motor

1. A DC electric starting system with positive engagement shall be furnished. The motor voltage shall be as recommended by the engine manufacturer.

B. Jacket Water Heater

1. Jacket water heater shall be provided and shall be sized to insure that genset will start within the specified time period and ambient conditions.

C. Batteries

1. Batteries - A lead-acid storage battery set of the heavy-duty diesel starting type shall be provided. Battery voltage shall be compatible with the starting system.

D. Battery Charger

1. Battery Charger - A current limiting battery charger shall be furnished to automatically recharge batteries. The charger shall be dual charge rate with automatic switching to the boost rate when required. The battery charger shall be mounted on the genset package or inside the genset enclosure/room.

2.12 ENCLOSURE

A. Sound Attenuated Enclosure

1. The complete diesel engine generator set, including generator control panel, engine starting batteries, and fuel oil tank, shall be enclosed in a factory assembled, sound attenuated enclosure mounted on the fuel tank base.

   a. A weather resistant, sound attenuated enclosure of steel with electrostatically applied powder coated baked polyester paint. The enclosure shall have a resulting sound level of 75dba @7m with the genset running under full load. It shall consist of a roof, side walls, and end walls. Fasteners shall be either zinc plated or stainless steel.

   b. The sound attenuated enclosure shall reduce the sound of the generator as required to meet all local, state and federal laws, codes, regulations, and standards.

   c. Enclosure Sound Attenuation: Acoustical foam shall be provided between all supports and inside doors and sound baffles on air intake and air discharge.

   d. Enclosure Color: Manufacturer's Standard Green

2. Convenience Receptacle and Lighting:

   a. Provide 120V 20A, Weatherproof, GFCI convenience receptacle integral to the generator enclosure.

   b. Interior Lights with Switch: DC lighting system arranged to illuminate controls and accessible interior.

3. Cold Weather Package

   a. Thermal insulation: manufacturers standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within the operating limits required by engine generator components.

   b. Horizontal/downflow space heater. Thermostatically controlled.

   c. Anti-condensation space heater: thermostatically controlled and sized to prevent condensation.

   d. Louvers: fixed air inlet and discharge. Storm-proof and drainable. Louvers prevent entry of rain and snow.

e. Automatic dampers: motorized air inlet and gravity discharge outlet. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.

2.13 PERFORMANCE AND CONSTRUCTION – ATS

A. The transfer switch shall be prototype tested, factory built, production tested, and site tested. A transfer switch with the number of poles, voltage, and current ratings shown on the plans and specified shall be provided.

B. The automatic transfer switch shall be of double throw construction operated by a reliable solenoid driven mechanism. There shall be a direct mechanical coupling to facilitate transfer in 6 cycles or less.

C. The normal and emergency contacts shall be mechanically interlocked such that failure of any coil or disarrangement of any part shall not permit a neutral position.

D. For switches installed in systems having ground fault protective devices, and/or wired so as to be designated a separately derived system by the NEC, a 4th pole shall be provided. This additional pole shall isolate the normal and emergency neutrals. The neutral pole shall have the same withstand and operational ratings as the other poles and shall be arranged to break last and make first to minimize neutral switching transients. Add-on or accessory poles that are not of identical construction and withstand capability will not be considered.

E. The contact structure shall consist of a main current carrying contact, which is a silver alloy with a minimum of 50 percent silver content. The current carrying contacts shall be protected by silver tungsten arcing contacts on all sizes above 400 Amps.

F. The transfer switch manufacturer shall submit test data for each size switch, showing it can withstand fault currents of the magnitude and the duration necessary to maintain the system integrity. Each ATS shall be in strict accordance and listed to UL 1008 withstand standards, including “Any Breaker” ratings. Minimum UL listed withstand and close into fault ratings shall be as indicated in Table 2.10A below. ATS’s which offer only “specific coordinated breaker” ratings (as opposed to “any breaker” ratings) do not meet this specification and are not acceptable.

Size (Amps)	Any Breaker Rating	Current Limiting Fuse
40 to 150	10,000	200,000
150 to 400	35,000	200,000
600 to 1200	65,000	200,000
1600 to 4000	100,000	200,000
(all values at 480V RMS symmetrical, less than 20 percent power factor)		

Table 2.10A – Minimum UL Listed Withstand And Close Into Fault Ratings

G. A dielectric test at the conclusion of the withstand and closing tests shall be performed.

H. The automatic transfer switch manufacturer shall certify sufficient arc interrupting capabilities for 50 cycles of operation between a normal and emergency source that are 120 degrees out of phase at 480 volts, 600 percent of rated current at .50 power factor. This certification is to ensure that there will be no current flow between the 2 isolated sources during switching.

I. All relays shall be continuous duty industrial type with wiping contacts. Coils, relays, timers and accessories shall be readily front accessible. The control panel and power section shall be interconnected with a harness and keyed disconnect plugs for maintenance.

J. Main and arcing contacts shall be visible without major disassembly to facilitate inspection and maintenance.

K. A manual handle shall be provided for maintenance purposes with the switch de-energized. An operator disconnect switch shall be provided to defeat automatic operation during maintenance, inspection or manual operation.

L. Switches composed of molded case breakers, lighting contactors or components thereof will not be acceptable.

M. The current rating shall be a continuous rating when the switch is installed in an enclosure, and shall conform to NEMA temperature rise standards.

N. The unit shall be rated based on all classes of loads, i.e., resistive, tungsten, ballast and inductive loads. Switches rated 400 amperes or less shall be UL listed for 100 percent tungsten lamp load.

O. Temperature rise tests in accordance with UL 1008 shall have been conducted after the overload and endurance tests to confirm the ability of the units to carry their rated currents within the allowable temperature limits.

P. Unless specified otherwise on the drawings, the switch shall be mounted in a NEMA 1 enclosure.

Q. The automatic transfer switch must be equipped with a solenoid production scheme that removes any attempts of operating the solenoids after (3) consecutive trials until manual intervention by an operator.

2.14 CONTROLS - ATS

A. The control panel shall be opto-isolated from electrical noise and provided with the following inherent control functions and capabilities: Easy-to-view, backlit LCD display with long lasting LED indicators.

1. Control panel shall display voltage and frequency of both sources.

2. The user shall be able to view the last 16 recorded events.

3. Capability for external communication and network interface

4. Adjustments to all settings shall be made from the front of the panel without opening the door.

B. The transfer switch shall be equipped with a microprocessor based control panel. The control panel shall perform the operational and display functions of the transfer switch. The display functions of the control panel shall include ATS position, source availability, sequence indication and diagnostics.

C. All programmable and control functions shall be pass code protected and accessible through the keypad.

D. The control panel shall be provided with a simple user interface for transfer switch monitoring, control and field changeable functions and settings.

E. Touch pad test switch with Fast Test/Load/No Load selection capability to simulate a normal source failure.

F. The controller shall include a built-in synchroscope to display the phase angle differential and ensure disturbance-free transfer operation between sources.

G. The controller shall provide digital timer adjustments with 1-second resolution. Voltage and Frequency shall be adjustable to 1 percent resolution to facilitate accurate transfer.

H. To ensure reliable and consistent user operation the controls must be equipped with nonvolatile memory and allow automatic daylight savings time adjustment.

I. A single controller capable of all transfer modes, open/delayed/closed and bypass isolation, shall be provided. Real time display of transfer status and active timers must be supplied.

2.15 SEQUENCE OF OPERATION

A. The ATS shall incorporate adjustable three phase under/over voltage and frequency sensing on the normal source.

B. When the voltage of any phase of the normal source is reduced to 80 percent of nominal voltage, for a period of 0-10 seconds (programmable) a pilot contact shall close to initiate starting of the engine generator.

C. The ATS shall incorporate adjustable three phase under/over voltage and frequency sensing on the emergency source.

D. When the emergency source has reached a voltage value of +/- 10 percent of nominal and achieved frequency within +/- 5 percent of the rated value, the load shall be transferred to the emergency source after a programmable time delay.

E. When the normal source has been restored to not less than 90 percent and not more than 105 percent of nominal voltage on all phases, the load shall be retransferred to the normal source after a time delay of 0 to 60 minutes (programmable; set at 30 minutes). The generator shall run unloaded for 5 minutes (programmable) and then automatically shut down. The generator shall be ready for automatic operation upon the next failure of the normal source.

F. If the engine generator should fail while carrying the load, retransfer to the normal source shall be made instantaneously upon restoration of proper voltage (90 percent) on the normal source.

G. Inspection and operational tests shall be conducted by the contractor in the presence of the engineer, to indicate that the switch satisfies the specifications.

H. The transfer switch shall be equipped with a microprocessor based control panel. The control panel shall perform the operational and display functions of the transfer switch. The display functions of the control panel shall include ATS position and source availability.

I. The digital display shall be accessible without opening the enclosure door and shall be provided with a 4 line by 20 character LCD display screen with touch pad functions and display menus. The programming functions shall be pass code protected.

J. The control panel shall be provided with menu driven display screens for transfer switch monitoring, control and field changeable functions and settings.

K. The control panel shall be opto-isolated from electrical noise and provided with the following inherent control functions and capabilities:

1. Multipurpose display for continuous monitoring and control of the ATS functions and settings: All field changeable functions shall be pass code protected and accessible through the keypad.

2. Built-in diagnostic display that includes the capturing of historical data, such as number of transfers and time on emergency power source, for ease of troubleshooting.

3. Capability for external communication and network interface through an RS485 serial port.

4. Touch pad test switch with Fast Test/Load/No Load positions to simulate a normal source failure.

5. Time delay to override momentary normal source failure prior to engine start: Field programmable 0-10 seconds (adjustable by increments of 0.1 second) factory set at 3 seconds.

6. Time delay on retransfer to normal source, programmable 0-60 minutes (adjustable by increments of 0.1 minute) factory set at 30 minutes: If the emergency source fails during the retransfer time delay, the transfer switch controls shall automatically bypass the time delay and immediately retransfer to the normal position.

7. Time delay on transfer to emergency, programmable 0-5 minutes, factory set at 1 second.

8. An in-phase monitor shall be provided. The monitor shall compare the phase angle difference between the normal and emergency sources and be programmed to anticipate the zero crossing point to minimize switching transients.

9. Auxiliary contacts (1 N.O.) shall be provided to indicate normal and emergency source availability.

10. A load/no load clock exerciser shall be incorporated within the microprocessor and shall be programmable to start the engine generator set and transfer the load (when selected) for exercise purposes on a weekly basis. The exerciser shall contain a lithium battery for memory retention during an outage.

11. A timed auxiliary contact (1 N.C.) adjustable 0-60 seconds shall be provided to allow motor loads to be disconnected prior to transfer in either direction.

12. Provide a momentary pushbutton to bypass the time delays on transfer and retransfer and programmable commit/no commit control logic.

2.16 ATS FEATURES

A. In addition to the operational elements required to satisfy the sequence of operation and other functions specified, the following ATS features shall be provided:

1. Adjustable time delay to override momentary normal source failure prior to engine start: Field programmable 0-10 seconds factory set at 3 seconds.

2. Adjustable time delay on retransfer to normal source, programmable 0-60 minutes factory set at 30 minutes: If the emergency source fails during the retransfer time delay, the transfer switch controls shall automatically bypass the time delay and immediately retransfer to the normal position.

3. A time delay on transfer to emergency, programmable 0-5 minutes, factory set at 1 second.

4. An in-phase monitor shall be provided. The monitor shall compare the phase angle difference between the normal and emergency sources and be programmed to anticipate the zero crossing point to minimize switching transients.

5. An exerciser timer with momentary test pushbutton shall be incorporated within the microprocessor and shall be capable of starting the engine generator set and transferring the load (when selected) for exercise purposes on a daily, weekly or monthly basis. The exerciser shall contain a battery for memory retention during an outage.

6. Provide a momentary pushbutton to bypass the time delays on transfer and retransfer and programmable commit/no commit control logic.

7. A set of customer contacts shall be provided to indicate both emergency and normal source position.

8. An adjustable over/under frequency and voltage sensor for both emergency and normal sources.

9. Visual indication of switch position and source acceptability shall be provided for both emergency and normal sources.

10. An engine start contact with an adjustable cool down timer.

11. A three phase Voltage Imbalance Monitor shall detect an imbalance and initiate a transfer to the alternate source. Adjustable 5-20 percent of nominal with a time delay of 10-30 seconds for nuisance conditions.

12. Heater and Thermostat (HT) – Recommended for NEMA 3R applications.

13. Communications interface card RS-485 Modbus.

14. Test Switch (6A) – Maintained.

15. Digital Meter (M90) - Measures and displays true RMS volts, amps, frequency, kW, kVA, kVAR and PF w/Modbus RS485.

16. Digital Meter (M91) Measures and displays true RMS volts, amps, frequency, kW, kVA, kVAR, PF and THD w/Modbus RS485.

17. Additional Auxiliary Contacts (A4) - Closed when the transfer switch is in Source 1 position.

18. Alarm panel (CTAP) – Alarm on transfer to emergency w/silence button & light.

19. Disconnect Switch (DS) - Inhibits transfer in either direction when in inhibit. (Std on 600A and above).

20. Protective Cover (OCVR) - Lockable see-through microprocessor and meters cover for NEMA 3R or 12.M.

21. Battery Charger (B9) – 5 amp float charger. Specify input/output voltage.

22. Fan Contact (F) – Contact closes when engine runs.

23. Analog Metering - Individual 2 percent ammeter, voltmeter or frequency meters with selector switches as specified.

24. Inhibit transfer (Q3) – Provides additional relay (specify voltage) to inhibit transfer to Emergency.

25. Inhibit transfer (Q7) – Provides additional relay (specify voltage) to inhibit transfer to Normal.

26. Load Shed (R15) – Provisions to transfer source 2 or Emergency to normal or neutral (delayed switches only) position. Specify voltage.

27. Engine Mode Switch (SW1) – Three-position engine selector switch (auto/test/off).

28. Keyed Engine Mode Switch (SW1K) – Three position keyed engine selector switch (auto/test/off).

29. Prime Source Selector (SW3) – Provide a source selector switch that selects source 1 or source 2 as the preferred source.

30. Prime Source Selector (SW3K) – Provide a keyed source selector switch that selects source 1 or source 2 as the preferred source.

31. Automatic or Manual Selector (S5) – Provide ability to manually transfer to Normal source.

32. Automatic or Manual Selector (S12) – Provide ability to manually transfer to Normal or Emergency sources.

33. Additional Auxiliary Contact (A3) - Closed when the transfer switch is in Source 2 position.

34. Additional Auxiliary Contact (A4) - Closed when the transfer switch is in Source 1 position.

35. Programmable Clock Exerciser (CDP) – This will replace the timer exerciser and allow for a 365 day cycle.

36. Peak Shave/Remote Test (Q2) - The controller shall accept a remote peak shave or test input to signal the transfer switch to the emergency position.

37. Phase Rotation Sensing (R16) – Rotation shall be monitored on both sources.

2.17 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Coordinate delivery, unloading and installation of generator set with on-Site construction activities.

B. Inspect equipment immediately upon delivery to Site for damage.

C. Install equipment in accordance with manufacturer's recommendations, the project drawings and specifications, and all applicable codes.

3.02 SERVICE

A. The supplier of the ATS shall be the same as that of the engine generator set and shall maintain a national service organization that is factory trained and certified for transfer switch equipment. In addition, the genset dealer organization shall be available 24 hours per day, 365 days per year.

3.03 START-UP AND TESTING

A. The transfer switch manufacturer shall perform a complete functional test on the switch, controller and accessories prior to shipping from the factory. A certified test report shall be available upon request.

B. Coordinate all start-up and testing activities with the Engineer and Owner. After installation is complete and normal power is available, the manufacturer's local dealer shall perform the following: Perform a 4-hour load bank test at a 1.0PF at full nameplate rating. Loadbank, cables and other equipment required for this test to be supplied by the genset supplier.

C. The manufacturer's representative shall provide inspection of the final installation. The manufacturer's representative shall perform site start-up and functional checkout of the control panel. Upon completion of the manufacturer's start-up and checkout, the manufacturer shall demonstrate to the customer all the automated sequences of operation as specified herein.

1. NFPA 110 Load Test Requirements

a. Verify that the equipment is installed properly.

b. Check all auxiliary devices for proper operation, including battery charger, jacket water heater(s), generator space heater, remote annunciator, etc.

c. Test all alarms and safety shutdown devices for proper operation and annunciation.

d. Check all fluid levels.

e. Start engine and check for exhaust, oil, fuel leaks, vibrations, etc.

f. Verify proper voltage and phase rotation at the transfer switch before connecting to the load.

g. Connect the generator to facility load and verify that the generator will start and run all designated loads.

h. The system shall be tested under full load and monitor the following readings:

1) Oil pressure

2) Coolant temperature

3) Battery charge rate

4) AC volts

5) AC Amperes- all phases

6) Frequency

7) Kilowatts

8) Ambient Temperature

3.04 OPERATION AND MAINTENANCE MANUALS

A. Provide 2 sets of operation and maintenance manuals covering the generator, switchgear, and auxiliary components. Include final as-built wiring interconnect diagrams and recommended preventative maintenance schedules.

3.05 TRAINING

A. On-Site Training

1. Provide on-site training to instruct the owner's personnel on the proper operation and maintenance of the equipment. Review operation and maintenance manuals, parts manuals, and emergency service procedures.

2. Training shall be provided in 2 complete separate sessions to accommodate plant staff of varying shifts.

3. The instruction shall be dedicated and intensive and shall be provided by competent instructors fully familiar with the equipment.

4. The instructions shall be presented in an eight hour session. The Field Service engineer will provide Instructions on the operation and maintenance of the generator engine, alternator, battery system, circuit breaker, control system, and appurtenances.

5. The Owner will provide a suitable classroom environment on site for the instruction session.

6. The owner may elect to record the training sessions for future reference.

7. Training shall be scheduled with at least 7 working days advance notice.

8. Provide both classroom training and hands-on equipment operation covering the following:

   a. Safety precautions

   b. Features and construction of generator and accessories

   c. Routine inspection, test and maintenance procedures

   d. Routine cleaning

   e. Routine preventative maintenance

   f. Interpretation of readings of indicating and alarm devices

   g. Review operating and maintenance manuals

h. Review troubleshooting operations

3.06 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.07 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.08 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 26 43 00

SURGE PROTECTIVE DEVICES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide surge protective device (SPD), in a panelboards in accordance with this Section and applicable reference standards listed in Article 1.03.

B. Related Requirements

1. Section 26 05 00 – Common Work Results for Electrical
2. Section 26 05 26 – Grounding and Bonding for Electrical Systems
3. Section 26 05 33 – Raceways and Boxes for Electrical Systems
4. Section 26 24 16 – Panelboards

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. Institute of Electrical and Electronics Engineers (IEEE)
   a. IEEE C62.41.1 - Guide on the Surge Environment in Low Voltage (1000 V and less) AC Power Circuits.
   b. IEEE C62.41.2 - Recommended Practice on Characterization of Surge Voltages in Low Voltage (1000 V and less) AC Power Circuits.
   c. IEEE C62.45 - Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and less) AC Power Circuits.
2. National Fire Protection Association (NFPA)
   a. NFPA 70 National Electrical Code

3. Underwriters Laboratories (UL)

   a. UL 1449 Surge Protective Devices

   b. UL 1283 Electromagnetic Interference Filters

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Closeout and maintenance material submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 SURGE PROTECTIVE DEVICE

A. Internal SPD

1. SPD shall be Listed in accordance with UL 1449 and UL 1283, Electromagnetic Interference Filters.

2. Integrated surge protective devices (SPD) shall be Component Recognized in accordance with UL 1449.

3. SPD shall be tested with the ANSI/IEEE Category C High exposure waveform.

4. SPD to provide suppression for all modes of protection: L-N, L-G, and N-G in WYE systems.

5. The manufacturer of the SPD shall be the same as the manufacturer of the service entrance and distribution equipment in which the devices are installed and shipped. Distribution equipment shall be fully tested and certified to the following UL standards.

   a. UL 67 - Panelboards

6. Recommended SPD ratings

   a. Minimum surge current ratings per phase of equipment shall be as follows:

EQUIPMENT	SURGE RATING
POWER PANELS	160kA
LIGHTING PANELS	160kA
RECEPTACLE PANELS	120kA

TABLE 2.01A – MINIMUM SURGE CURRENT RATINGS

   b. UL 1449 clamping voltage must not exceed the following:

VOLTAGE	L-N	L-G	N-G
240/120	800/400V	800/400V	400V
208/120	400V	400V	400V
480/277	800V	800V	800V
600/347	1200V	1200V	1200V

TABLE 2.01B – MAXIMUM CLAMPING VOLTAGE LIMITS

   c. Pulse life test: Capable of protecting against and surviving 5000 ANSI/IEEE Category C High transients without failure or degradation of clamping voltage by more than 10 percent.

7. SPD shall be designed to withstand a maximum continuous operating voltage (MCOV) of not less than 115 percent of nominal RMS voltage.

8. SPD shall be constructed of one self-contained suppression module per phase.

9. Visible indication of proper SPD connection and operation shall be provided. The indicator lights shall indicate which phase as well as which module is fully operable. The status of each SPD module shall be monitored on the front cover of the enclosure as well as on the module. A push-to-test button shall be provided to test each phase indicator. Push-to-test button shall activate a state change of dry contacts for testing purposes.

10. SPD shall be equipped with an audible alarm which shall activate when any one of the surge current modules has reached an end-of-life condition. An alarm on/off switch shall be provided to silence the alarm. The switches and alarm shall be located on the front cover of the enclosure.

11. A connector shall be provided along with dry contacts (normally open or normally closed) to allow connection to a remote monitor or other system. The output of the dry contacts shall indicate an end-of-life condition for the complete SPD or module.

12. Terminals shall be provided for necessary power and ground connections.

13. The SPD shall be equipped the following items:

    a. Locate a transient voltage surge counter on the diagnostic panel on front cover of enclosure. Equip counter with a manual reset and battery backup to retain memory upon loss of AC power.

    b. A remote monitoring device shall be provided to directly connect to the SPD with a dry contact connector for simple installation. The device will have indicator lights and an audible alarm to monitor for normal and fault conditions.

B. SPD shall have a warranty for a period of 10 years from date of invoice. Warranty shall be the responsibility of the electrical distribution equipment manufacturer and shall be supported by their respective field service division.

2.02 MANUFACTURERS

A. Square D by Schneider Electric

B. ABB

C. Siemens

D. Eaton/Cutler Hammer

E. Or equal

2.03 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer’s requirements.

3.02 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.03 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.04 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 26 51 00

INTERIOR LIGHTING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide labor, tools, equipment, and materials necessary to furnish and install lighting fixtures in accordance with this Section and applicable reference standards listed in Article 1.03.

2. Provide complete lighting system as indicated. Lighting control equipment shall include, if indicated: light fixtures, control modules, power packs, dimming ballasts, occupancy sensors, and light level sensors.

   a. Light Emitting Diode (LED) Luminaires

   b. Photocell controls

B. Related Requirements

1. Section 26 05 00 – Common Work Results for Electrical

2. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables

3. Section 26 05 26 – Grounding and Bonding for Electrical Systems

4. Section 26 05 33 – Raceways and Boxes for Electrical Systems

5. Section 26 56 00 – Exterior Lighting

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. Edison Electric Institute (EEI)

2. Institute of Electrical and Electronics Engineers (IEEE)

   a. IEEE C2 National Electrical Safety Code

b. IEEE C62.41 IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits

c. IEEE C62.45 IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits

3. Illuminating Engineering Society of North America (IES)

a. IESNA HB-9 Lighting Handbook

4. National Fire Protection Association (NFPA)

a. NFPA 70 National Electrical Code (NEC)

b. NFPA 101 Life Safety Code

5. National Electrical Manufacturer's Association (NEMA)

6. Underwriters Laboratories (UL)

a. UL 508 Industrial Control Equipment

b. UL 773 Plug-In Locking Type Photocontrols for Use with Area Lighting

c. UL 773A Standard for Nonindustrial Photoelectric Switches for Lighting Control

d. UL 924 Standard for Emergency Lighting and Power Equipment

e. UL 1778 Uninterruptible Power Systems

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Shop Drawings: indicate construction details for products which are not manufacturer's standard, when product data does not adequately describe fixture physical characteristics, or upon request by Engineer.

C. Product data: for each luminaire and lighting unit.

D. Submit luminaire Shop Drawings in booklet form with a separate sheet for each luminaire type. Indicate on each sheet the proposed luminaire type designation, manufacturer, luminaire, lamp, and ballast designation.

E. Indicate materials, finishes, metal gauges, overall and detail dimensions, sizes of electrical and mechanical connections, fasteners, welds, joints, end conditions, provisions for work of others and similar information.

F. Include a photometric test report showing photometric candlepower distribution, brightness, coefficients of utilization, and paint reflectance for fluorescent and HID fixtures. Prepare photometric reports for actual fixture, lamp, lens, and ballast combination. Certify data under IES National Bureau of Standards calibrated test conditions. Upon request, submit photometric test of proposed fixture prepared by an independent testing laboratory.

G. Submittals stating whether or not the fixture, as an assembly, has been UL tested and approved.

H. Upon request, submit sample products for inspection. Provide luminaires identical with approved samples; retain approved samples at Site for comparison until after all other luminaires have been installed. Upon notification of disapproval, immediately submit new samples meeting requirements.

I. Upon request by Engineer, provide computerized illumination calculation data for specified interior areas in digital or isofootcandle format and in detail requested.

J. Closeout and maintenance material submittals: per Division 01 General Requirements.

1. Provide maintenance and operating instructions for battery powered lighting units. Include technical data sheets and parts ordering information for components used in luminaires.

2. Provide specific instructions for calibration and troubleshooting as part of the O&M manual representing the range of applications on the Project.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Provide products of firms regularly engaged in the manufacture of interior luminaires or components of similar types and ratings to those specified. Products shall have been in satisfactory use in similar applications for not less than 2 years.

1.07 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Division 01 General Requirements

B. Deliver luminaires and components to Site, factory assembled and wired to greatest extent practical, in strict accordance with approved Shop Drawings, Samples, certificates and catalog cuts.

C. Protect exposed finishes during manufacture, transport, storage and handling. Replace damaged materials.

D. Store luminaires above ground, under cover, in clean, dry areas, tagged or marked with type and Site destination.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 GENERAL

A. Provide lighting fixtures as listed on the Lighting, Lamping, and Fixture Schedule, on Drawings and as specified, meeting the performance and quality standard for that fixture. Provide substitutes equal in all respects including mechanical, electrical, physical, performance, photometric and quality characteristics except minor variances in construction details, which do not affect overall quality or performance.

B. Provide required accessories for mounting and operation of each luminaire as indicated.

1. Recessed luminaires: trim type suitable for ceiling system in which luminaire is installed; design fixtures to operate in a 140 degree F environment.

2. Thermal protection devices meeting NFPA 70.

3. Provide disconnecting means in fluorescent luminaires that utilize double-ended lamps and contain ballasts that can be serviced in place.

4. Provide spacers and brackets required for surface luminaire mounting. Design for a minimum ambient temperature of 92 degree F.

5. Pendant luminaires: provide swivel hangers, pendant rods, tubes, chains and other hardware as required or indicated to install luminaire.

2.02 LED LIGHT FIXTURES

A. General

1. LED light fixtures in accordance with IES, NFPA, UL, as shown on Drawings, and as specified.

2. LED light fixtures: Reduction of Hazardous Substances (RoHS) compliant.

3. LED drivers shall include the following features unless otherwise indicated:

   a. Minimum efficiency: 85 percent at full load.

   b. Minimum Operating Ambient Temperature: -20˚ C. (-4˚ F.)

   c. Input Voltage: 120 - 277V (±10%) at 60 Hz, uless otherwise specified on Lighting Fixture Schedule.

   d. Integral short circuit, open circuit, and overload protection.

   e. Power Factor: ≥ 0.95.

   f. Total Harmonic Distortion: ≤ 20 percent.

   g. Comply with CFR 47 Part 15.

4. LED modules including the following features unless otherwise indicated.

   a. Comply with IES LM-79 and LM-80 requirements.

   b. Minimum CRI 80 and color temperature 3000˚ K unless otherwise specified in Lighting Fixture Schedule.

   c. Minimum Rated Life: 50,000 hours per IES L70.

   d. Light output lumens as indicated in the Lighting Fixture Schedule.

B. LED Downlights

1. Provide housing, LED driver, and LED module products from the same manufacturer.

C. LED Troffers

1. LED drivers, modules, and reflector accessible, serviceable, and replaceable from below the ceiling.

2. Provide housing, LED driver, and LED module products from the same manufacturer.

2.03 LAMPS

A. Provide type and color indicated on the Lighting, Lamping, and Fixture Schedule.

2.04 PHOTOCELL SWITCH

A. Provide UL 773 or UL 773A, hermetically sealed cadmium-sulphide cell rated 240 volts AC, 60 hertz with single-throw contacts rated 1000 watts, and 600 volts.

B. Mount switch in a cast weatherproof aluminum housing, with swivel arm mount, in a high impact resistant, non-corroding and non-conductive molded plastic housing, with an EEI-NEMA locking-type receptacle.

C. Switch shall turn on below 3 footcandles and off at 3 to 10 footcandles. A time delay will prevent accidental switching from transient light sources. Mount a directional lens in front of cell to prevent fixed light sources from creating a turnoff condition. Aim switch according to manufacturer's recommendations.

2.05 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Electrical installations must conform to IEEE C2, NFPA 70, and to requirements specified.

B. Examine adjacent surfaces to determine surfaces are ready to receive Work.

C. Install wiring in accordance with Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.

D. Install luminaires and accessories according to manufacturer's instructions, as indicated, with equipment, materials, parts, attachments, devices, hardware, hangers, cables, supports, channels, frames and brackets necessary to make a safe, complete and fully operative installation.

E. Install luminaires plumb, square and level with ceiling and walls, in alignment with adjacent luminaires, and secure according to NFPA 70, manufacturers' directions and approved Shop Drawings.

1. Specified or indicated mounting heights are to be to the bottom of each luminaire for suspended and ceiling mounted luminaires, and to the center of each luminaire for wall mounted luminaires. Obtain approval of exact mounting for luminaires on the Site before installation is commenced and, where applicable, after coordinating with type, style, and pattern of ceiling being installed.

2. Provide pendant accessory to mount suspended luminaires and exit signs at height indicated. Use swivel hangers on sloped ceilings.

3. Support surface mounted luminaires from ceiling grid tee structure. Provide auxiliary support laid across top of ceiling tees and fasten to prohibit movement.

4. Install recessed luminaires to permit removal from below and install earthquake clips.

5. For lighting fixtures mounted in or on suspended ceilings, provide 2 support hangers per fixture so each is independently supported from the building structure.

6. Provide 2 support hangers for the minimum-security fixtures so each is independently supported from the building structure.

7. Install lamps in luminaires and lamp holders.

8. Ground non-current carrying parts of electrical equipment in accordance with UL and NEC.

F. Install lighting fixtures where indicated on Drawings. Drawings may be scaled for approximate locations. Minor adjustments are permitted to avoid conflicts. Correct fixture placement that does not conform to layout indicated. If in doubt about correct placement, consult Engineer prior to roughing in. Install lighting so it is securely fastened, rows are uniformly spaced and in alignment, and fixture rests flat on mounting surface.

G. Install ballasts and fixtures to avoid amplifying hum. Any ballast or fixture which develops an excessive hum within 1-year will be replaced.

H. Where multilevel switching is indicated, all outer lamps shall be switched together and all inner lamps together.

I. Install 2 x 2 fixtures for consistent lamp orientation within each room.

J. Perform insulation resistance and ground continuity test.

K. Wire emergency lighting units ahead of the switch to the normal lighting circuit located in the same room or area.

L. Exit signs may only have 1 control from the dedicated circuit breaker. Wire exit signs to a dedicated circuit breaker from nearest available panelboard. Paint control device red, label circuit and provide lockout device.

3.02 ADJUSTING AND CLEANING

A. Align luminaires and clean lenses and diffusers at completion of Work.

B. Aim adjustable luminaires and lamp holders as indicated or as directed.

C. Adjust directional arrows on exit signs to meet approval of authority having jurisdiction.

D. Clean paint splatters, dirt and debris from installed luminaires.

E. Touch up luminaire and pole finish at completion of Work.

F. Replace luminaires which have failed at completion of Work at no additional cost to the Owner.

G. Calibration and Troubleshooting

1. Perform occupant sensor calibration prior to system turnover. Recheck and recalibrate 3 months later, or as recommended by sensor manufacturer. Provide on-Site training by a system manufacturer representative in spaces representing the range of applications on the Project. Training to include appropriate maintenance personnel from the building operations staff.

3.03 OWNER INSTRUCTION

A. Provide on-Site training of Owner’s personnel in operation of controls systems by a factory trained manufacturer's representative. Include programming time controls instruction to obtain required control functions. Provide 1 follow-up visit if necessary.

3.04 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.05 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

B. Provide the services of a qualified manufacturer’s representative to perform programming, startup and training services of the low-voltage lighting controls systems.

3.06 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 26 56 00

EXTERIOR LIGHTING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide exterior lighting in accordance with this Section and applicable references listed in Article 1.03.

B. Related Requirements

1. Section 26 05 00 – Common Work Results for Electrical
2. Section 26 05 33 – Raceways and Boxes for Electrical Systems
3. Section 26 05 26 – Grounding and Bonding for Electrical Systems
4. Section 26 51 00 – Interior Lighting

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. Illuminating Engineering Society (IES)
2. National Fire Protection Association (NFPA)
    a. NFPA 70 National Electrical Code (NEC)
    b. NFPA 101 Life Safety Code

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Shop Drawings: indicate construction details for products which are not manufacturer's standard, when product data does not adequately describe fixture physical characteristics, or upon request by Engineer.

C. Product data: for each luminaire and lighting unit.

D. For LED lighting fixtures, submit US DOE LED Lighting Facts label, and IES L70 rated life.

E. Submit luminaire Shop Drawings in booklet form with a separate sheet for each luminaire type. Indicate on each sheet the proposed luminaire type designation, manufacturer, luminaire lamp, and ballast designation.

F. Indicate materials, finishes, metal gauges, overall and detail dimensions, sizes of electrical and mechanical connections, fasteners, welds, joints, end conditions, provisions for work of others and similar information.

G. Include a photometric test report showing photometric candlepower distribution, brightness, coefficients of utilization, and paint reflectance included for all fixtures. Prepare photometric reports for actual fixture, lamp, lens, and ballast combination. Certify data under IES National Bureau of Standards calibrated test conditions. Upon request, submit photometric test of proposed fixture prepared by an independent testing laboratory.

H. Submittals stating whether or not the fixture, as an assembly, has been UL tested and approved.

I. Upon request, submit sample products for inspection. Provide luminaires identical with approved samples; retain approved samples at Site for comparison until after all other luminaires have been installed. Upon notification of disapproval, immediately submit new samples meeting requirements.

J. Upon request by Engineer, provide computerized illumination calculation data for specified exterior areas in digital or isofootcandle format and in detail requested.

K. Closeout and maintenance material submittals: per Division 01 General Requirements.

1. Provide maintenance and operating instructions for battery powered lighting units. Include technical data sheets and parts ordering information for components used in luminaires.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Provide products of firms regularly engaged in the manufacture of exterior luminaires or components of similar types and ratings to those specified. Products shall have been in satisfactory use in similar applications for not less than 2 years.

1.07 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Deliver luminaires and their components to Site, factory assembled and wired to the greatest extent practical, in strict accordance with approved shop drawings, samples, certificates and catalog cuts.

C. Protect exposed finishes during manufacture, transport, storage and handling; replace damaged materials.

D. Store luminaires above ground, under cover, in clean, dry areas, tagged or marked with type and Site destination.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 GENERAL

A. Provide lighting fixtures as listed on the Lighting, Lamping, and Fixture Schedule on Drawings and as specified meeting the performance and quality standard for that fixture. Provide substitutes equal in all respects including mechanical, electrical, physical, performance, photometric, and quality characteristics except minor variances in construction details, which do not affect overall quality or performance.

B. Provide required accessories for mounting and operation of each luminaire as indicated.

2.02 LUMINAIRES

A. Provide weatherproof, heavy duty, outdoor type luminaires designed for efficient light utilization, adequate dissipation of lamp and ballast heat, and safe cleaning.

B. Illumination distribution patterns, BUG ratings and cutoff types according to IES and as shown on Drawings.

C. Incorporate drivers in luminaire housing, except where otherwise shown on Drawings.

D. Provide frame-mounted, heat-resistant, borosilicate glass lenses, with prismatic refractors, unless otherwise shown on Drawings. Attach frame to the luminaire housing by hinges or chain. Use heat and aging-resistant, resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

E. Pre-wire internal components to terminal strips at the factory.

F. Bracket-mounted luminaires to have leveling provisions and clamp-type adjustable slip-fitters with locking screws.

G. Materials to be rustproof. Latches and fittings to be non-ferrous metal.

H. Provide manufacturer's standard finish, as scheduled on the Drawings. Where indicated on Drawings, match finish process and color of pole or support materials.

I. Luminaires shall carry factory labels, showing complete, specific lamp and ballast information.

2.03 LAMPS

A. Install the proper lamps in every luminaire installed and every existing luminaire relocated or reinstalled as shown on the drawings.

B. Lamps shall be general-service, outdoor lighting types.

C. LED sources shall meet the following requirements.

1. Operating temperature rating shall be between -40 degrees C (-40 degrees F) and 50 degrees C (120 degrees F).

2. Correlated Color Temperature (CCT): 4000K.

3. Color Rendering Index (CRI): ≥ 85.

4. The manufacturer shall have performed reliability tests on the LEDs luminaires complying with Illuminating Engineering Society (IES) LM79 for photometric performance and LM80 for lumen maintenance and L70 life.

D. Mercury vapor lamps shall not be used.

2.04 LED DRIVERS

A. LED drivers shall meet the following requirements.

1. Drivers shall have a minimum efficiency of 85 percent.

2. Starting Temperature: -40 degrees C (-40 degrees F).

3. Input Voltage: 120 to 480 (±10 percent) volt.

4. Power Supplies: Class I or II output.

5. Surge Protection: system must survive 250 repetitive strikes of "C Low" (C Low: 6kV/1.2 x 50 µs, 10kA/8 x 20 µs) waveforms at 1-minute intervals with less than 10 percent degradation in clamping voltage. "C Low" waveforms are as defined in IEEE/ASNI C62.41.2-2002, Scenario 1 Location Category C.

6. Power Factor (PF): ≥ 0.90.

7. Total Harmonic Distortion (THD): ≤ 20 percent.

8. Comply with FCC Title 47 CFR Part 18 Non-consumer RFI/EMI Standards.

9. Drivers shall be reduction of hazardous substances (ROHS)-compliant.

2.05 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Construct luminaire pole bases as indicated on Drawings. Furnish pole bases for installation under Division 02 and coordinate installation.

B. Provide anchor bases with galvanized steel anchor bolts, threaded at the top end and bent 90 degrees at the bottom end. Provide galvanized nuts, washers, and ornamental covers for anchor bolts. Concrete for anchor bases as specified in Division 03. Polyvinyl chloride (PVC) conduit ells as specified in 26 05 33.

C. Thoroughly compact backfill with compacting arranged to prevent any pressure between conductor, jacket, or sheath and the end of conduit ell. Adjust poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location.

D. Ground noncurrent-carrying parts of equipment, including metal poles. Where the copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

3.02 ADJUSTING AND CLEANING

A. Clean lenses and diffusers at completion of work.

B. Aim adjustable luminaires and lampholders as indicated or as directed.

C. Clean paint splatters, dirt, and debris from installed luminaires.

D. Touch up luminaire and pole finish at completion of Work.

E. Replace luminaires which have failed at completion of work at no additional cost to the Owner.

3.03 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

B. Field tests: upon completion of installation, conduct an operating test to show that the equipment operates in accordance with the requirements of this Specification.

C. Insulation resistance test: perform before and after connection of fixtures and equipment.

D. Ground resistance tests: perform ground continuity test.

3.04 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

B. Provide the services of a qualified manufacturer’s representative to perform programming, startup and training services for the wireless site lighting system.

C. Provide on-Site training of Owner’s personnel in operation of the exterior lighting control systems by a factory trained manufacturer's representative. Include programming time controls instruction to obtain required control functions. Provide 1 follow-up visits if necessary.

3.05 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide Site clearing and grubbing in accordance with this Section.

B. Related Requirements

1. Section 32 90 00 – Planting

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Definitions

1. Clearing: cutting and disposing of trees, downed timber, stubs, brush, bushes, snags, rubbish, debris, and other objectionable matter and materials, and removal and storage of fences, signs, walks, guard rails, curbs and items to be restored.

2. Grubbing: removal and disposal of stumps, roots, duff, foundations and other objectionable matter, and materials to a minimum of 6 inches below original ground surface.

3. Topsoil: friable loam surface soil found in a depth of not less than 4 inches from original ground surface. Satisfactory topsoil: reasonably free of subsoil, clay lumps, stones, and objects over 2 inches in diameter, and free of weeds, roots, and other objectionable material.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Closeout and maintenance material submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Store trees, plants and shrubs in protected areas and provide water to keep them in thriving condition for replanting.

C. Store slate and flagstone walk sections, granite and stone curbs, fences, signs, guard rails and other items removed for reinstallation at approved locations.

D. Do not obstruct roads, driveways, sidewalks, gutters and drainage ditches, swales and channels with stored materials.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verification of Conditions

1. Verify Site conditions. Trees, plantings, vegetation, sidewalks, curbs and other living and nonliving item locations shown on Drawings were determined by actual surveys and conditions may have changed.

2. Verify limiting boundaries, such as permanent and temporary easements, property lines, rights-of-way and grading limits, have been located and marked.

3. Verify pipeline routings and other items of Work have been located and marked.

3.02 PREPARATION

A. Mark trees, plantings and other items to be removed, trimmed, cut, or removed and preserved. Inspect items with Engineer prior to start of Work. Do not remove or trim unmarked items unless approved by Engineer.

B. Protect existing trees and vegetation indicated to remain in place against cutting, breaking or skinning of roots, skinning and bruising of bark, smothering by stockpiling construction or excavated materials within drip line, excess foot or vehicular traffic, or vehicle parking within drip line. Provide temporary guards to protect trees and vegetation to be left standing.

C. Protect existing objects. Avoid interference with use of, and passage to and from adjacent buildings, facilities, driveways, walks, drainage systems and road.

D. Remove highway signs, guard rails and other control, safety, and warning devices just prior to installation of Work.

E. Notify affected property owners at least 4 days in advance of fence removal. Do not remove fencing more than 48 hours in advance unless written permission is received from property owner.

F. Leave items affecting traffic, safety, containment of humans and animals, and essential to protection of property or operation of a business, in place until Work is ready to be installed. Restore items immediately after installation.

3.03 IMPLEMENTATION

A. General

1. Use of explosives for clearing and grubbing operations is not allowed.

2. Limit clearing and grubbing to preserve plantings and natural vegetation. Perform Work so present growth will blend with limits of construction and attain natural appearance.

3. Confine clearing and grubbing operations within grading limits as shown on Drawings, and within Owner easements and property lines.

4. Provide measures to avoid erosion.

5. Do not disturb property markers unless absolutely necessary. If necessary to disturb or remove a property marker, employ a professional land surveyor licensed in the state where the Project is located to establish property marker location; mark area, and replace property marker immediately, in compliance with Division 01 General Requirements.

B. Stripping Topsoil

1. Strip topsoil within limits indicated on Drawings, or as required to prevent mixing with underlying subsoil or objectionable material.

2. Prevent damage to main root system of trees indicated to be left standing.

3. Stockpile topsoil in areas shown on Drawings, or where directed, and provide for drainage of surface water. Protect stockpiles to prevent windblown dust and erosion.

4. Stockpile surplus material on-Site. Surplus loam and topsoil not required for completion of Work will remain on Owner's property. Maintain and protect until Work is complete.

C. Trees and Plantings

1. Remove only items marked for removal in grassed, planted and open areas.

2. Trees

a. Notify property owners 1 month in advance of tree trimming or removal to allow property owner to cut and remove trees and retain debris, unless otherwise directed.

b. Remove or trim trees in wooded areas only as required. Minimize damage to trees left standing. Immediately remove and legally dispose of debris.

c. Take possession of timber and wood removed.

d. Trim trees evenly to achieve neat appearance with least possible damage to trees.

e. Apply wet burlap to prevent drying where roots are cut or damaged.

D. Pavements, Walks, Curbs and Guard Rails

1. Remove existing pavements, walks, and curbs to limits shown on Drawings, or if not shown, to minimum extent possible to complete the work.

2. Saw-cut pavements to be removed, including highways, driveways and walks. Remove when Work is ready to be installed.

3. Remove slate and flag stone walks, granite and stone curbs, and guard rails to minimum extent possible. Terminate removals at joint or guard rail post. Store and protect for reuse.

E. Walls, Fences, and Other Obstructions

1. Remove walls, fences, signs, sheds and other obstructions and store for replacement after verification with Owner and Engineer.

2. Protect existing structures during Work.

F. Remove and legally dispose of materials not specified to be stored or reused. Do not burn debris unless approved and required permits obtained.

G. Comply with Section 32 90 00 for replanting and restoring surfaces.

H. Replace and restore items and materials removed to original conditions.

I. Replace items damaged during removal, storage or re-installation.

3.04 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.05 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 31 25 00

EROSION AND SEDIMENTATION CONTROLS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide and install permanent devices to control erosion, siltation, and sedimentation in accordance with this Section and applicable reference standards listed in Article 1.03.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. MassDEP – Massachusetts Erosion & Sedimentation Control Guidelines for Urban and Suburban Areas

2. MassDOT

a. Standard Specifications for Highways and Bridges, Supplemental Specifications, and Construction Details

1) Section 767 – Mulching, Seed for Erosion Control

2) M6.04.2 Straw Mulch

3. Order of Conditions

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data: for permanent erosion control matting.

C. Manufacturer’s Instructions

D. Closeout and maintenance material submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements

PART 2 – PRODUCTS

2.01 MATERIALS

A. Permanent Erosion Control Blanket

1. Provide as shown on Drawings or as directed by Engineer in compliance with the Order of Conditions to prevent slope erosion. If sequence of operations is such that only portions of slopes have been completed, preserve those portions by seeding and installation of erosion control blanket when directed, prior to completion of remaining portions of slope.

2. Provide soft pine wood wedges and stakes of biodegradable materials as recommended by manufacturer.

3. Coir log: coconut fiber mats woven into a matrix in compliance with the following.

PROPERTY	Test Method	Parameter
Weight	ASTM D 3776	17.8 oz/SY (600 g/m2)
Wide width tensile strength **Wet** Machine direction Cross direction	ASTM D 4595	 910 lbs/ft (13.3 kN/m) 870 lbs/foot (12.7 kN/m)
Wide width tensile strength **Dry** Machine direction Cross direction	ASTM D 4595	 1130 lbs/foot (16.5 kN/m) 1040 lbs/foot (15.2 kN/m)
Elongation at failure **Wet** Machine direction Cross direction	ASTM D 4595	 32 percent 26 percent
Open area	Calculated	58 percent
Thickness	ASTM D 177	0.35 inch (9 mm)
Recommended shear stress		4 lbs./sq. ft. (192 N/sq.m.)
Recommended flow		10 fps (3 m/s)
Recommend slope		2:1

B. Straw mulch: MassDOT M6.04.2, long fibered straw, 100 percent certified weed free, free from foreign matter detrimental to plant life, and in dry condition.

C. Tackifier: biodegradable and non-toxic bonding adhesive agent during hydraulic seeding or straw mulching to minimize wind and water effects.

2.02 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 GENERAL

A. Prevent erosion of soil and to prevent silting of drainage ditches, storm sewers, rivers, streams, and lakes.

B. Limit duration of exposure of soils on embankments, excavations, and graded areas.

C. Install erosion control measures in any ditch, swale or channel before runoff flows to waterways.

3.02 PREPARATION

A. Protection

1. Provide pollution prevention measures, erosion and sedimentation control, before, during and after soils are exposed. Implement and maintain erosion and sedimentation control measures as necessary until Site is permanently stabilized.

2. Stabilize areas shown on Drawings with permanent erosion control practices immediately, and within 14 days after construction activity on a particular portion of Site has permanently ceased, except where construction activities will resume on the particular portion of Site within 21 days, and where snow cover precludes initiation of stabilization measures.

B. Conform to existing grades and cross sections for slopes.

C. Finish to a smooth and even condition. Rake out and remove debris, roots, stones, and lumps.

D. Loosen soil surface to permit bedding of matting.

E. Apply seed prior to placement.

F. Dewater trenches and swales to install materials in the dry.

3.03 INSTALLATION

A. Install erosion control blanket and straw mulch in accordance with manufacturer's instructions, the following, and as shown on Drawings or directed by Engineer. Submit manufacturer's instructions to Engineer prior to installation. Place immediately following seeding.

B. Install erosion control blanket onto slopes that have been graded, seeded, completed to required line and where grades are steeper than or equal to 3:1 as shown on Drawings and directed by Engineer.

C. Place strips lengthwise in direction of flow of water.

D. Overlap ends at least 6 inches in a shingle fashion.

E. Turn down up-slope end of each strip of matting and bury to a depth of not less than 6 inches with soil firmly tamped against it.

F. Engineer may require that any edge exposed to more than normal flow of water be buried in a similar manner.

G. Build check slots at right angles to direction of flow of water. Space so one check slot or one end occurs within each 50 feet of slope length. Construct by placing a tight fold of matting at least 6 inches vertically into ground, and tamp same as up-slope ends.

H. When directed by Engineer, spread additional seed over matting, particularly at locations disturbed by building the slots. Press matting onto ground with a light lawn roller or similar means.

I. Use pine wedges to fasten coir to ground. Metal staples are not allowed. Pound vertically flush to surrounding surface, not protruding above finished grade. Place pine wedges in same locations as recommended by manufacturer for staples.

J. On grades 4:1 or steeper, place pine wedges in same 3 rows, but spaced 2 feet apart.

K. On overlapping or butting edges, double pine wedges, with spacing halved. Secure ends of matting and required check slots spaced every foot.

L. Apply weed free straw mulch in combination with erosion control blanket on side slopes steeper than 3:1.

M. Place mulch according to MassDOT Section 767. Do not use short fibered material or material so wet or decayed that it cannot be properly spread. Apply tackifier as needed.

N. Maintain areas mulched or matted, until Project acceptance.

O. Maintain swales by removing silt that reaches a depth of over one foot, until Project acceptance.

3.04 REPAIR/RESTORATION

A. Repair matting immediately if any pine anchors become loosened or raised, or if any matting becomes loose, torn, or undermined.

3.05 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

B. Site/Field Tests and Inspections

1. Inspections of disturbed soil areas, material storage areas exposed to precipitation and erosion control measures will be conducted by both Contractor and Engineer a minimum of once every 14 days and also within 24 hours after any storm event greater than 0.5 inches of rainfall. Immediately correct deficiencies identified.

2. Inspect erosion control blanket immediately after each rainfall and at least daily during prolonged rainfall or snowmelt for damage. Make appropriate repairs or replacement until acceptance by Engineer.

3.06 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 32 12 16

ASPHALT PAVING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide asphalt paving in accordance with this Section and the Drawings and applicable reference standards listed in Article 1.03.

2. Work includes temporary trench paving, permanent trench paving, milling, pavement reclamation, structure protection and adjustments, sidewalks, driveways, hot mix asphalt berm and curb, and miscellaneous patching.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. American Association of State Highway and Transportation Officials (AASHTO)

a. AASHTO T209 Standard Method of Test for Theoretical Maximum Specific Gravity (Gmm) and Density of Hot Mix Asphalt (HMA)

2. Commonwealth of Massachusetts Department of Transportation (MassDOT)

a. Standard Specifications for Highways and Bridges, Supplemental Specifications, and Construction Details

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Certificates: manufacturer's certificate verifying conformance.

C. Mix design: for each grade of pavement used, at least 20 days prior to start of paving.

D. Source and field quality control submittals

1. Certified weigh slips for each truck load of bituminous material

E. Closeout and maintenance material submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Comply with road opening permits.

C. Establish and control pavement (aggregate or asphalt base course and asphalt surface course) alignments, grades, elevations, and cross sections to match existing and prevent ponding.

D. Hot mix asphalt production facility: approved per MassDOT Section 460, M3.12.0.

E. Hot mix asphalt materials testing laboratory and equipment: approved and qualified per MassDOT Section 460, M3.13.0.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 PERFORMANCE GRADED ASPHALT BINDER

A. Provide in accordance with MassDOT Section 460, M3.01.0.

2.02 ASPHALT ADDITIVES

A. Warm mix asphalt additive: per MassDOT Section 460, M3.01.4.

B. Asphalt anti-stripping additive: per MassDOT Section 460, M3.01.5.

2.03 ASPHALT RELEASE AGENTS

A. Provide in accordance with MassDOT Section 460, M3.01.6.

2.04 ASPHALT EMULSION FOR TACK COAT

A. Provide in accordance with MassDOT Section 460, M3.03.0.

2.05 HOT-APPLIED PAVEMENT JOINT ADHESIVE

A. Provide in accordance with MassDOT Section 460, M3.05.4.

2.06 HOT MIX ASPHALT

A. Provide in accordance with MassDOT Section 460, M3.06.0.

1. Hot mix asphalt pavement courses and mixture types: in accordance with MassDOT Section 460, Table 460.10-1, and the Drawings.

2. Hot mix asphalt design: in accordance with MassDOT Section 460.31.

2.07 HOT MIX ASPHALT FOR BERM

A. Provide in accordance with MassDOT Section 470, M3.07.0.

2.08 HOT MIX ASPHALT FOR MISCELLANEOUS WORK

A. Provide in accordance with MassDOT Section 472.

2.09 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements. Comply with applicable reference standards listed in Article 1.03.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify subgrade is dry and in suitable condition to begin paving.

B. Proceed with paving only after unsatisfactory conditions have been corrected.

3.02 GENERAL

A. Minimize area of pavement removed to suitable width for installation of Work. Legally dispose of existing pavements.

B. Place hot mix asphalt between April 1 and November 15, unless otherwise specified by Owner.

C. Do not place hot mix asphalt mixture unless breakdown and intermediate rolling can be completed by time material has cooled to 175 degrees F, and provided density of completed pavement attains at least 92.5 percent of maximum theoretical density as determined by AASHTO T209.

D. Do not place mix on wet or damp surfaces, or when ambient temperature is 40 degrees F and falling, unless otherwise specified by Owner.

E. When air temperature falls below 50 degrees F, take extra precaution drying aggregates, controlling temperatures of materials, placing, and compacting mixtures.

F. Use straightedge to check compacted surfaces and obtain Engineer's approval.

G. Utilize approved dial type thermometer and infrared pistol thermometer for each paving machine. Retain thermometer upon completion of Project.

1. Fahrenheit or Celsius selectable

2. Portable and battery operated

3. Repeatability: plus or minus 5 degrees F.

4. LCD display: to nearest 1 degree.

5. Accuracy: plus or minus 2 percent.

6. Emissivity: present at 0.95.

7. Temperature operation range: 0 degrees F to 750 degrees F.

3.03 MILLING OF EXISTING HOT MIX ASPHALT PAVEMENT

A. Mill existing hot mix asphalt pavement in accordance with MassDOT Section 415 and Construction Standard Details, where indicated on Drawings.

3.04 INSTALLATION

A. Place hot mix asphalt base and top courses on roadways, sidewalks and other areas to maintain traffic access and egress to properties abutting Work, and for safe passage of pedestrian and vehicular traffic in accordance with MassDOT Section 460 and Construction Standard Details.

1. Provide minimum compacted thickness depth of hot mix asphalt base course indicated on Drawings or as directed by Engineer to achieve necessary base course grade in support of finish grade pavement elevations.

2. Apply bitumen for prime and tack coat at a rate of 0.07 gallons per square yard over milled areas immediately prior to installation of top course, as shown on Drawings or directed by Engineer. Clean surface of sand and foreign matter, and dry before applying prime coat.

3. Apply bitumen for prime and tack coat at a rate of 0.05 gallons per square yard over hot mix asphalt base course immediately prior to installation of top course, as shown on Drawings or directed by Engineer. Clean surface of sand and foreign matter, and dry before applying prime coat.

4. Provide minimum compacted thickness depth of hot mix asphalt surface course indicated on Drawings or as directed by Engineer to achieve finish grades.

5. Apply pavement joint adhesive to longitudinal and transverse joints.

6. Remove and replace defective mix not conforming to specified mix formula within stipulated tolerances on basis of testing. Samples of mixture in use will be taken as many times daily as necessary, and mixtures maintained uniform as specified. Owner may suspend further approval of plant mixtures in related Work if mixtures are not uniformly furnished as specified, until necessary changes have been made so mixtures conform to specified requirements.

7. Irregularities which may develop before completion of rolling, and while material is still workable, may be remedied by loosening surface mixture and removing or adding material as necessary. If irregularities or surface defects remain after final compaction, defective Work will be corrected by minor surface projections, joints, and minor honeycombed surfaces ironed out smoothly to grade, and as directed.

8. If any soft, imperfect places or spots develop on surface before final acceptance of Work, remove and replace with new materials and compact until edges of new Work seamlessly connect with old Work.

B. Install hot-applied pavement joint adhesive on roadway cracks less than or equal to 1-inch width. Clean and dry crack to minimum depth of twice the crack width with high-pressure air blast prior to placing joint adhesive. Apply joint adhesive according to manufacturer's recommendations.

C. Install hot mix asphalt by handwork on roadway surfaces in locations where irregularities, inaccessibility or other unavoidable obstacles prevent mechanical spreading and finishing.

D. Maintain safe passage of vehicular and pedestrian traffic and access and egress.

E. Set manhole covers and valve boxes flush with finish grade of top course.

F. Do not permit vehicular traffic or loads on newly completed pavement until adequate stability has been attained and material has cooled sufficiently to prevent distortion or loss of fines. If climate or other conditions warrant, the time-period for opening to traffic may be extended, at discretion of Owner.

3.05 RECLAMATION OF ROADWAY WITH PAVING

A. Locate and protect existing drainage and utility structures, underground pipes, culverts, conduits and other appurtenances prior to scarifying and pulverizing existing pavement. If upper sections of utilities are removed, immediately cover remaining part of structure with steel plate capable of withstanding 36.5-ton truckload with impact. Protect, remove or replace existing utility structures and boxes as part of Work.

B. Reclamation of paving in accordance with MassDOT Section 403 includes scarifying and pulverizing in-place pavement and underlying material, mixing or blending material in depths indicated on Drawings, followed by placing Type I-1 binder course in depths specified on Drawings and Type I-1 top course in depths specified on Drawings.

C. Remove unsuitable material in sub-grade to lines and depths established by Owner and dispose of legally. Replace with gravel borrow in accordance with MassDOT M1.03.0.

D. Placement: within limits of Work shown on Drawings.

3.06 TEMPORARY TRENCH PAVEMENT

A. Comply with the construction method requirements of MassDOT Section 420, MassDOT Section 460 and the Drawings.

B. Grade gravel base to the depths required for installation of temporary trench pavement and compact gravel base prior to installing pavement.

C. Install temporary trench pavement over gravel base to the limits and thickness shown on the Drawings. Compact temporary trench pavement in accordance with MassDOT Section 460.

D. Unless otherwise directed by Owner, temporary trench pavement shall remain in place for one winter season. Maintain temporary pavement and repair settlement or failures until permanent pavement is installed at no additional cost to the Owner.

E. No more than 1,000 linear feet of unpaved trenches shall be permitted at any time. Owner reserves the right to further limit the length of unpaved trenches with no additional compensation to the Contractor.

F. Provide temporary trench paving for each trench excavated, excluding plated areas, at the end of each workday, unless otherwise approved by Owner. Bring any trench excavated and left unpaved at the end of each workday, excluding plated areas, to uniform grade with gravel borrow or gravel base course. Provide that unpaved trench is level and smooth with surrounding pavement to minimize traffic impacts Unpaved trenches during holidays or over weekends are not be permitted.

3.01 PERMANENT TRENCH PAVEMENT

A. Comply with the construction method requirements of MassDOT Section 420 and MassDOT Section 460.

B. Remove temporary trench pavement to the depths and limits shown on the Drawings. Provide neat, straight cuts and square, vertical edges. Seal seams and joints with hot-applied pavement joint adhesive.

C. Clean sand, dirt, debris and other foreign materials from surfaces before applying tack coat. Apply bituminous tack coat to clean, dry vertical edges and existing paved surfaces to bond existing and new pavement.

D. Provide necessary protection for roadway castings to prevent damage to castings and vehicles and ensure pedestrian safety.

E. Install hot mix asphalt base and top courses to the limits and lift depths indicated on the Drawings. Compact each lift in accordance with MassDOT Section 460. Match existing grades and install permanent trench pavement to maintain or improve existing drainage patterns.

3.02 HOT MIX ASPHALT BERM

A. Replace existing hot-mix asphalt berms damaged by the Work in kind. Provide foundation for hot-mix asphalt berms per Drawings or as directed by Engineer, conforming to requirements for type of berm.

B. Place mixture and compact with machine approved by Owner for type of berm required.

3.03 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.04 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

3.05 MAINTENANCE

A. Maintain trench width pavement during Warranty Period. Refill areas that have settled or are unsatisfactory for traffic.

END OF SECTION

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SECTION 32 90 00

PLANTING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide loam borrow, topsoil, seeding, and supporting materials and m planting trees, shrubs and groundcover, in accordance with this Section and applicable reference standards listed in Article 1.03.

B. Related Requirements

1. Section 31 00 00 – Earthwork

2. Section 31 25 00 – Erosion and Sediment Control

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. American National Standards Institute (ANSI)

a. ANSI Z60.1 American Standard for Nursery Stock

2. AOAC International (AOAC)

3. ASTM International (ASTM)

a. ASTM D75 Standard Practice for Sampling Aggregates

b. ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort

c. ASTM D6913 Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.

d. ASTM D7928 Standard Test Methods for Particle-Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation (Hydrometer) Analysis.

4. MassDOT

    a. Standard Specifications and Supplements, and Construction Standard Details.

5. United States Department of Agriculture (USDA)

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data

1. Seeding and planting fertilizer showing composition and analysis

    a. Fertilization rates for fertilizer product based upon soil testing, analysis, and recommendations

    b. Receipt showing total quantity purchased for Project prior to installation

C. Samples and Mockups: as specified in Article 1.06.

D. Certificates: seeding and planting fertilizer composition and analysis.

E. Manufacturer Instructions

F. Source and Field Quality Control Submittals

1. Suppliers' certified analysis in accordance with AOAC for non-standard products.

2. Suppliers' certified analysis for soil amendments and fertilizer materials.

3. Seed Supplier's certified statement for each grass seed mixture required, stating botanical and common name, percentage by weight, and percentages of purity germination and weed seed for each grass seed species.

4. Certificates of agronomic rates from Supplier for organic matter used in loam borrow manufacturing process.

5. Supplier's certifications for peat moss, limestone, acidulants, gypsum, additives needed to amend a specific soil.

G. Provide submittals at least 30 days prior to ordering materials.

H. Closeout and maintenance material submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Survey data of on-Site topsoil stockpiles plotted on a 20-scale plan of the Site, prepared by a registered surveyor or civil engineer

C. Samples

1. Loam borrow: 1 cubic foot representative sample per each 1,000 cubic yards of proposed stockpile of loam borrow for testing. Stockpile sampling: in accordance with ASTM D75**.**

2. On-Site stockpiles of loam borrow: 25 one cubic foot representative samples selected for testing or from loam after it has been spread and amended. Take Samples from on-Site stockpiles and from spread and amended loam borrow from locations as directed by Engineer and packaged in presence of Engineer.

3. Deliver samples to testing laboratories via overnight courier and have testing reports sent directly to Engineer.

a. Obtain testing for gradation, organic content, soil chemistry and pH by a certified laboratory.

b. Include the following tests.

1) Sieve analysis: performed and compared to USDA Soil Taxonomy, by combined hydrometer and wet sieving using sodium hexametaphosphate as a dispersant in compliance with ASTM D6913 and ASTM D7928 after destruction of organic matter by H2O2. Provide a computer generated gradation curve from UMASS Laboratory to facilitate review and approval of sieve analysis.

2) Determine percent of organics by loss on ignition of oven dried samples. Oven dry test samples minus #10 material to a constant weight at a temperature of 450 degrees F.

3) Provide chemical analysis for nitrate nitrogen, ammonium nitrogen, phosphorus, potassium, calcium, magnesium, extractable aluminum, lead, zinc, cadmium, copper, soluble salts, and pH and buffer pH. Use a conductivity meter to measure soluble salts in 1:2 soil/water (v/v %). Nutrient tests: for available nutrients.

4) Provide recommendations for soil additives to correct soil deficiencies, and additives necessary to complete planting work specified with soil analysis tests.

c. Provide biosolid compost testing to determine compost is mature, stable and suitable for use in a growing medium by Woods End Research Laboratory, Mt. Vernon, ME.

d. Provide analysis by recognized laboratory for other materials in accordance with AOAC, where applicable.

4. Peat moss: 1-cubic foot sample.

5. Gypsum: 2-pound sample.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Packing, Shipping, Handling, and Unloading

1. Do not order or deliver material until submittals are approved.

2. Package products with manufacturers certified analysis.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 LOAM BORROW

A. Provide in accordance with MassDOT Section 751 and MassDOT Construction Details.

B. Type: MassDOT Section M1.05.0.

C. Furnish sufficient loam borrow to complete loaming operations required for Project and as directed by Engineer. Obtain loam borrow from the following sources and meet requirements specified after testing and addition of necessary soil additives.

1. Naturally well-drained areas that have never been stripped before and have a history of satisfactory vegetative growth. Comply with bylaws and Regulations regarding removal of topsoil.

2. Commercial processing facility specializing in manufacturing of loam.

2.02 TOPSOIL

A. Provide additional topsoil required to complete landscape work if quantity of stockpiled topsoil is insufficient.

B. Furnish new topsoil, which is fertile, friable, natural loam surface soil found at a depth of not less than 4 inches from original ground surface, reasonably free of subsoil, clay lumps, brush, weeds and other litter, and free of roots, stumps, debris, and stones larger than 2 inches in any dimension.

C. Obtain topsoil from local sources or from areas having similar soil characteristics as Site. Obtain topsoil only from naturally, well-drained Sites where topsoil occurs in a depth of not less than 4 inches. Do not obtain from bogs or marshes.

2.03 SEED AND SUPPORTING MATERIAL

A. Provide seed, limestone, fertilizers, plant materials, water for irrigation and soil conditioners in accordance with MassDOT Section 765.40 and MassDOT Construction Details, and ANSI Z60.1.

B. If biosolid compost (Massachusetts Department of Environmental Protection-permitted material) is used as an organic component of proposed planting soil mixture, amount of organic material used shall not exceed agronomic rates for nitrogen and phosphorus for trees and shrubs, turf or ornamental perennials.

2.04 PLANTING TREES, SHRUBS AND GROUNDCOVER

A. Furnish in accordance with MassDOT Section 771s.

B. Type: per MassDOT Section M6.06.1

2.05 GRASS SEED

A. Furnish fresh, clean, new crop seed, complying with tolerance for purity and germination established by AOSA. Do not use wet, moldy, or damaged seed. Seed mixtures listed below are proportions by weight.

1. Germination: minimum 80 percent.

2. Purity: minimum 85 percent.

3. Weed content: maximum 1 percent.

B. Roadside Mixture

1. 50 percent Creeping Red Fescue

2. 15 percent Kentucky Bluegrass

3. 2 percent Red Top Clover

4. 25 percent Annual Ryegrass

5. 3 percent Bird's Foot Trefoil, Variety Empire

6. 5 percent White Clover

C. Ecology Mixture

1. 50 percent Creeping Red Fescue

2. 5 percent White Clover

3. 15 percent Kentucky Bluegrass

4. 2 percent Red Top Clover

5. 25 percent Annual Ryegrass

6. 3 percent Bird's Foot Trefoil, Variety Empire

D. Wetlands Edge Mixture

1. 55 percent Tall Fescue

2. 10 percent Poa Trivialis

3. 15 percent Kentucky Bluegrass

4. 5 percent Redtop

5. 10 percent Perennial Ryegrass

6. 5 percent Reed Canary Grass

E. Lawn Repair Mixture

1. 60 percent Kentucky Bluegrass

2. 20 percent Perennial Ryegrass

3. 20 percent Chewings Fescue

F. New England Conservation Seed Mixture

1. Acceptable level of quality: equivalent to that manufactured by New England Wetland Plants.

2. Big Bluestem (Andropogon gerardii)

3. Switchgrass (Panicum virgatum)

4. Little Bluestem (Schizachyrium scoparium)

5. Canada Wild Rye (Elymus canadensis)

6. Fox Sedge (Carex vulpinoidea)

7. Partridge Pea (Chamaecrista fasciculata)

8. Fringed Bromegrass (Bromus ciliatus)

9. Pennsylvania Smartweed (Polygonum pensylvanicum)

10. Common Milkweed (Asclepias syriaca)

11. Showy Tick-Trefoil (Desmodium canadense)

12. New England Aster (Aster novae-angliae)

13. Flat-top Aster (Aster umbellatus)

14. Nodding Bur Marigold (Bidens cernua)

2.06 FERTILIZER

A. Bone meal: commercial, raw or steamed, finely ground; minimum of 4 percent nitrogen and 20 percent phosphoric acid.

B. Superphosphate: commercial, phosphate mixture, soluble; minimum of 20 percent available phosphoric acid.

C. Fertilizer: commercial grade complete fertilizer of neutral character, consisting of fast and slow release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition.

1. Nitrogen, phosphorous and potassium in amounts recommended in topsoil analysis reports from a qualified soil testing agency.

2. Minimum 1 pound per 1,000 square feet of actual nitrogen, 4 percent phosphorous and 2 percent potassium by weight.

2.07 EROSION AND SEDIMENTATION CONTROL

A. Anti-erosion mulch: clean, seed-free threshed straw of wheat, rye, oats, or barley. Do not use hay.

B. Erosion control mesh: uniform, open-weave jute matting or flexible vinyl mat. Acceptable level of quality: equivalent to Mira Mat erosion control.

C. Acceptable level of quality for re-vegetation mat: equivalent to TenCate Mirafi.

2.08 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 GENERAL

A. Avoid damage to utilities, buildings and private property.

B. Do not disturb property markers.

C. Immediately report damage to Engineer.

D. Complete landscape work immediately as portions of Site become available, working within seasonal limitations for each kind work. Notify Engineer before planting if conditions detrimental to plant growth are encountered.

E. Plant or install materials during normal planting seasons for each type of landscape work required.

F. Use topsoil stockpiled for re-use as specified in Section 31 00 00.

3.02 LOAM BORROW

A. Place loam borrow at designated locations where plant material is to be installed or re-installed in accordance with MassDOT Section 751 and MassDOT Construction Details and Drawings, or as directed by Engineer.

B. Protect loam borrow delivered to Site from erosion and spread immediately. Cover material that sits on-Site for more than 24 hours with tarpaulin or other soil erosion system acceptable to Engineer, and surround with silt fence as shown on Drawings.

C. Do not handle, plant or use loam borrow if wet or frozen. Use moist loam borrow.

3.03 PLANTING TREES, SHRUBS AND GROUNDCOVER

A. Provide in accordance with MassDOT Section 771 and MassDOT Construction Details.

B. Type: per MassDOT Section M6.06.1

C. Prune injured roots or branches to make clean-cut ends prior to planting, utilizing clean, sharp tools, removing only injured or diseased branching.

D. Remove planting containers, baskets, and non-biodegradable materials from root balls during planting. Cut natural fiber burlap from around trunk of trees and folded down against root ball prior to backfilling.

E. Position trees and shrubs at intended locations shown on Drawings and obtain Engineer's approval prior to excavating pits, making necessary adjustments as directed.

F. Dig planting pits with level bottoms with width twice the diameter of root ball. Rest root ball on undisturbed grade. Backfill each plant pit in layers with thoroughly mixed, prepared soil; 1-part peat moss; 1-part composted cow manure by volume; 3 parts topsoil by volume.

1. Provide 21-gram planting tablets, acceptable level of quality: equivalent to Agriform.

a. 2 tablets per 1-gallon plant

b. 3 tablets per 5-gallon plant

c. 4 tablets per 15-gallon plant

d. Larger plants: 2 tablets per 1/2-inch caliper of trunk

G. Fill prepared soil around ball of plant halfway, and insert plant tablets. Complete backfill, and water thoroughly.

3.04 FINE GRADING

A. Clean subgrade of stones greater than 2 inches and all debris immediately prior to dumping and spreading loam borrow, and remove from Site. Do not rake to edges and bury. Obtain Engineer's approval of subgrade conditions prior to spreading loam borrow.

B. Spread and thoroughly incorporate soil additives into layer of loam borrow by harrowing or other approved methods. Incorporate the following soil additives.

1. Ground limestone or acidulants: as required by soil analysis to achieve required pH specified. Spread limestone at rate required by soil analysis up to maximum limit of 200 pounds per 1,000 square feet. Make a surface application of limestone not in excess of 50 pounds per 1,000 square feet to established planting area during the season after Final Acceptance if recommendations of soil analysis require rates of application greater than 200 pounds per 1,000 square feet.

2. Fertilize at rate and analysis recommended by soil analysis.

3. Use biosolid compost, peat moss, sand or other soil amendments as required by soil analysis.

C. Prepare loam borrow by scarifying, harrowing, or tilling loam to integrate soil additives into top 6 inches of loam after loam borrow and required additives have been spread. Remove large stiff clods, lumps, brush, roots, stumps, litter and other foreign matter. Remove all stones over 1-inch in diameter from top 6 inches of loam bed from unscreened soils. Remove smaller stones in excessive quantities as directed.

D. Set sufficient grade stakes for checking finished grades. Set stakes in bottom of swales and at top of slopes. Do not deviate more than one-tenth of foot from indicated elevations. Connect contours and spot elevations with an even slope. Finish grades: smooth and continuous with no abrupt changes at top or bottom of slopes.

E. Fill depressions caused by settlement or rolling during compaction process with additional loam borrow and regrade surface and roll until finish is smooth and even corresponding to required grades.

F. Install loam borrow in successive horizontal lifts no thicker than 6 inches in turf areas and 12 inches in plant bed areas to desired compaction as indicated. Install soil at a higher level to anticipate any reduction of loam borrow volume due to compaction, settling, erosion, and decomposition during Warranty Period. Obtain full depths of loam borrow for plant beds by digging holes in loam borrow at same frequency as for compaction testing.

1. Compact loam to specified density.

2. Maximum dry density for topsoil and loam: determined in accordance with ASTM D698. Achieve the following percentages of minimum to maximum dry densities for fill materials or prepared subgrades.

    a. Fills within plant beds, tree pits and treeways: minimum 80 percent; maximum 85 percent for areas in top 18 inches of finished grade.

3. Scarify surface area of each lift by raking prior to placing next lift.

G. Compact each lift to reduce settling, but not enough to prevent movement of water and feeder roots through the soil in addition to range cited above. Loam borrow in each lift: firm underfoot and make only slight heel prints. Loam borrow at completion of installation: firm, even resistance when a soil sampling tube is inserted from lift to lift. Perform percolation tests after placement of each lift to determine if soil has been over compacted using the following percolation test procedure.

1. Dig a hole in installed soil minimum of 4 inches in diameter. Holes in 6-inch lift in turf areas: 4 inches deep. Holes in 12-inch lifts in plant beds: 8 inches deep. Do not penetrate through lift being tested.

2. Fill hole with water and let it drain completely. Immediately refill hole with water and measure rate of fall in water level.

3. Till soil to a depth required to break over compaction if water drains at a rate less than 1-inch per hour.

4. Perform a minimum of 1 soil percolation test per 10,000 square feet of turf area, and 2,500 square feet of tree and shrub planting area as directed.

H. Select equipment and phase installation of loam borrow so wheeled equipment does not travel over subsoil, placed fills or ordinary borrow, or already installed soil. Movement of tracked equipment over these soils will be reviewed and considered by Engineer for approval. If Engineer determines that wheeled equipment must travel over already installed soil, provide a written description of sequencing of Work that ensures compacted soil is loosened and uncompacted as Work progresses, or place 1-inch thick steel plate ballast or approved equivalent over length and width of any travelway to cover loam borrow to protect it from compaction.

I. Grade disturbed areas outside limit of Work, smooth and spread with minimum 6 inches of loam borrow to finished grade.

J. Maintain stockpiles of existing on-Site topsoil until final placement of existing on-Site topsoil and loam borrow is approved. Provide survey data plotted on a 20-scale plan of the Site prepared by a registered surveyor or civil engineer, showing volume of stockpiles of existing on-Site topsoil. Remove excess, unused existing on-Site topsoil from Site and legally dispose of upon approval.

3.01 SEED AND SUPPORTING MATERIAL

A. Install and apply seed and supporting materials at rates of application in accordance with MassDOT Section 765.40 and MassDOT Construction Details and the Drawings.

3.02 HYDROSEEDING NEW AREAS

A. Mix specified seed and pulverized mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogenous slurry suitable for hydraulic application.

B. Apply slurry using an approved machine. Seed and suitable corn fiber mulch may be applied in 1 operation. Mix materials with water in machine and agitate to keep mixture uniformly suspended. Use spraying equipment that will distribute slurry uniformly at required rates.

C. Mulch areas with anti-erosion mulch with mulch blower at rate of 1,200 pounds per acre on level grades, 2,000 pounds on slopes if mulch is not part of slurry, immediately following hydroseeding.

D. Seed only areas that can be mulched on same day.

3.03 SEEDING NEW AREAS

A. Sow seed using a spreader or seeding machine. Do not seed when wind velocity exceeds 5 miles per hour. Distribute seed evenly over entire area by sowing equal quantity in 2 directions at right angles to each other.

B. Do not sow immediately following rain or when ground is too dry.

C. Seed application rate

1. New England Conservation Seed Mix: 1 pound per 1,750 square feet.

2. All others: 1 pound per 1,000 square feet.

D. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

3.01 PROTECTION OF SEEDED SLOPES

A. Protect seeded slopes against erosion with erosion netting or other acceptable methods.

B. Spread specified mulch after completion of seeding operations to form a continuous blanket not less than 1-1/2 inches' loose measurement over seeded areas.

C. Anchor mulch by spraying with asphalt emulsion at rate of 10 to 13 gallons per 1,000 square feet. Prevent damage or staining of construction or other plantings adjacent to mulched areas.

D. Cover seeded slopes with jute matting where grade is 3:1 or greater. Roll matting down over slopes without stretching or pulling.

E. Lay matting smoothly on soil surface, burying top end of each section in narrow 6-inch trench. Leave 12-inch overlap from top roll over bottom roll. Leave 4-inch overlap over adjacent section.

F. Staple outside edges and overlaps at 36-inch intervals.

G. Lightly dress slopes with topsoil to ensure close contact between matting and soil.

H. Unroll matting in direction of flow in ditches. Overlap ends of strips 6 inches with upstream section on top.

3.02 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

B. Replace rejected Work, and continue specified maintenance until re-inspected by Engineer and accepted. Remove rejected plants and materials promptly from Site.

3.01 CLEANING

A. Keep pavement, sidewalks, and walkways clean. Maintain protection during installation and maintenance periods.

3.02 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

3.03 MAINTENANCE

A. Provide maintenance of grass seeded areas immediately after planting.

B. Maintain grass by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, re-grading, and replanting as required to establish smooth, acceptable lawn areas free of eroded or bare areas.

C. Maintain grassed areas to establish acceptable lawn until Final Completion or for a minimum of 180 days, whichever is longer, by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, re-grading, and replanting as required to establish a smooth, acceptable lawn, free of eroded or bare areas.

D. Maintain trees and shrubs until Final Completion, or for a minimum of 180 days, whichever is longer.

END OF SECTION

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SECTION 40 00 00

BASIC PROCESS MATERIALS AND METHODS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide process equipment and appurtenances in accordance with this Section and applicable reference standards listed in Article 1.03.

2. The following Specification outlines general requirements for process equipment and appurtenances specified in Divisions 40 through 43 as well as general information and requirements, which pertains to the Drawings. Refer to the individual equipment and product specifications in Divisions 40 through 43 for additional details.

B. Related Requirements

1. Section 09 90 00 - Painting and Coating

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. American National Standards Institute (ANSI)

a. ANSI A13.1 Scheme for the Identification of Piping Systems

b. ANSI S12.19 Measurement of Occupational Noise Exposure

2. ASTM International (ASTM)

a. ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

b. ASTM A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

c. ASTM A307 Standard Specification for Carbon Steel Bolts and Studs, 60000 PSI Tensile Strength

d. ASTM B117 Standard Practice for Operating Salt Spray (Fog) Apparatus

3. National Electrical Manufacturers Association (NEMA)

a. NEMA MG 1 Standard for Motors and Generators

b. NEMA MG 11 Energy Management Guide for Selection and Use of Single Phase Motors

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data

1. Qualifications of Manufacturers

2. Warranties

3. Submittal Deviations

4. Drawing Modifications

5. Special Tools

6. Spare Parts

7. Nameplates

8. Equipment Tag Nameplates

9. Field Painting of Equipment

C. All submittals shall include but are not limited to all deviations from the Contract Documents, any and all necessary modifications to the Drawings, all special tools required for maintenance and operation, all spare parts required for normal maintenance of equipment during the manufacturer's Warranty Period, and Samples of information which will be included on equipment, instrument and tank nameplates.

D. Submit engraved equipment and tank nameplates for all equipment, (including associated instrumentation), bearing the alphanumeric tag number and the descriptive name of the equipment as it is referenced on the Drawings.

E. Submit a coordinated process system color scheme finished coating of all ferrous metallic and painted surfaces of new and existing equipment; including but not limited to pipes, valves, motors, gearboxes, supports, base plates, drive guards, enclosures and all associated appurtenances. All painting shall be in accordance with Section 09 90 00.

F. Submittal Deviations: Provide submittals to the Engineer of all products and equipment for compliance with the Contract Documents. Submittals for Design Basis products; Named products and equipment other than the design basis; as well as Engineer Approved Equal products and equipment shall specifically outline all deviations from the Contract Documents. Submittals that do not specifically outline all deviations from the Contract Documents will be rejected.

G. Closeout and maintenance material submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Qualifications: per Division 01 General Requirements for design and production of products and as follows.

1. All materials and equipment specified shall be the standard products of a manufacturer regularly engaged in the production of such products and shall essentially duplicate items that have been in satisfactory use in identical applications in other wastewater treatment facilities.

2. The manufacturer shall have a minimum of 5 years of documented experience in the design and production of products and equipment of all types, and not less than 5 years of experience in the production of equal or larger sized models of the exact products and equipment specified in each individual section unless otherwise indicated in the individual Specification sections or indicated on the Drawings.

C. Unless otherwise specified or indicated on the Drawings, all product and equipment manufacturers shall provide an installation list of at least 10 similar United States installations, including contact names and phone numbers. Products and equipment shall be supported by a service organization that is, in the opinion of the Engineer, reasonably convenient to the Site to ensure parts and service can be acquired in a timely fashion

1. The term installations shall mean individual Projects/Contracts. Multiple equipment units for a Project will be considered as 1 installation toward meeting the experience requirements. Installations shall be only those in the United States. Installations shall include, but are not limited to the following

2. Name and location of installation

3. Name of person in direct responsible charge for the products and equipment

4. Address and phone number of person in direct responsible charge

5. Month and year the equipment was placed in operation

6. Brief description of equipment

7. Provide the name, address, and phone number of the contact person at the company that provided service (both Warranty Period and post-Warranty Period) for the unit to the Owner

D. To ensure quality, conformance, and reliability with regard to the manufacturing and production of the equipment, the manufacturer shall meet or exceed all the requirements of the Contract Documents for each respective product and piece of equipment

1.07 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance Division 01 General Requirements.

B. The equipment manufacturers shall coat all machined surfaces subject to corrosion with an easily removable rust preventive compound prior to shipment. Ship fabricated assemblies in the largest sections permitted by carrier Regulations. All products shall be properly labeled to ensure proper field erection. Deliver all equipment in the manufacturer's original, unopened and undamaged packages, unless mounted on the respective equipment assembles. Store and maintain all equipment in strict accordance with the manufacturer's written short term and long-term storage requirements.

C. Store all products in a manner to protect items with epoxy shop coatings from exposure to UV light, which may cause chalking of the epoxy. Length of acceptable exposure prior to providing UV protective measures shall be in accordance with the coating manufacturer's recommendations. This shall include protection from UV light after installation while awaiting covering or filling of tanks, or prior to field painting for items scheduled to be finish coated. Should damage occur, the Contractor shall immediately make all repairs and replacements necessary to the satisfaction of the Engineer at no additional cost to the Owner.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

1.09 WARRANTY

A. Special Warranty/Extended Correction Period: Division 01 and individual specification sections in Divisions 40 through 43.

PART 2 – PRODUCTS

2.01 NAMED PRODUCT AND EQUIPMENT MANUFACTURERS

A. Acceptable manufacturers may be listed in each Specification section within Divisions 40 through 43. Manufacturer's names listed in each Specification within Divisions 40 through 43 are intended to indicate the type and quality of materials desired. Where the words Engineer approved equal is indicated, other manufacturers of equal quality that comply fully with the Contract Documents shall be allowed.

B. The Contract Documents direct attention to certain required features of the equipment but do not purport to cover all details entering into its design and construction. Nevertheless, provide products and equipment complete in all details and ready for operation for the intended purpose.

C. The Specifications in Divisions 40 through 43 are intended to provide standard products and equipment of a recognized manufacturer meeting all the requirements of the Contract Documents. Due to differences in equipment and products of various manufacturers, provide complete and detailed submittals for the Engineer to review.

D. All equipment and products of the same type, style, and duty shall be supplied by a single manufacturer. All manufacturers named shall comply completely with the Contract Documents. The Drawings are typically based upon a single product or piece of equipment. As such, the physical installation, all services, all connections, and all appurtenances are designed around the characteristics of a single product or piece of equipment. Other named manufacturers of products and equipment as well as Engineer approved equal manufacturers will be considered.

E. However, named manufacturers' products and equipment other than the design basis, as well as Engineer approved equal manufacturers' products and equipment will differ slightly from the Contract Documents. Modifications, including but not limited to, piping, wiring, controls, foundations, other services, and structures shall be required. Coordinate these modifications with the Engineer. Any additional costs required for these modifications shall be at no additional cost to the Owner or Engineer. No change in Contract time shall be granted for these modifications.

2.02 GENERAL ELECTRICAL REQUIREMENTS

A. Provide motors with their respective pieces of equipment. Motors and controllers shall conform to and have electrical connections as described in the Contract Documents. Provide internal wiring for components of packaged equipment as an integral part of the equipment. Extended voltage range motors shall not be permitted under any circumstances.

B. Controllers and contactors shall have a maximum of 120 volt control circuits, and shall have auxiliary contacts for use with the controls furnished. All electrical work shall conform to NFPA 70 standards and the Contract Documents.

2.03 ELECTRICAL CLASSIFICATIONS AND HAZARD RATINGS

A. Electrical information including but not limited to motor horsepower values, voltage, phase, cycle, hazard classification rating, inverter duty, etc., have been listed for each respective product or piece of equipment in the respective Specification sections for ease in bidding, construction, reference, and submittal review.

B. The Contract Documents specifically outline electrical hazard classifications by area. In the case that a discrepancy between the hazard classification listed in the respective product or equipment specification section and the Contract Documents or Specifications should arise; the Drawings shall govern the electrical hazard classification of the associated equipment or product and all related appurtenances. It shall be the responsibility of the Contractor and the product and equipment manufacturers to ensure all such items furnished meet the electrical hazard classification ratings which are shown on the Drawings or as indicated in the Specifications.

2.04 ELECTRIC MOTORS - GENERAL

A. Unless otherwise specified or indicated on the Drawings, all electric motors shall conform to the requirements set forth. All electric motors shall be of sufficient capacity to operate the products and equipment under all load and operating conditions without exceeding rated nameplate current, power, or specified temperature limit.

B. When the horsepower rating is specified for a motor, the motor furnished shall meet the requirements of the output specified. In the event a horsepower rating is not specified, the motor provided shall have sufficient capacity to operate the driven products and equipment as outlined in the detailed Specifications.

C. All electric motors shall have either UL or FM approval ratings. All electric motors shall have a minimum service factor of 1.0, unless otherwise specified or indicated on the Drawings. Motors for use with variable frequency drives (VFD) shall have a minimum service factor of 1.15 and be specifically designed for inverter duty service.

2.05 ELECTRIC MOTOR DESIGN STANDARDS

A. Unless otherwise indicated, all motors shall be NEMA Design B. Motors shall have starting characteristics and ruggedness as required under the actual conditions of operation and, unless otherwise specified, shall be suitable for full-voltage starting.

B. All electric motors shall be manufactured by General Electric Co., Baldor-Reliance, Toshiba, Siemens, WEG or an Engineer approved equal product that meets all the specified requirements.

C. Unless otherwise indicated, all electric motors shall have Class F insulation with a temperature rise in accordance with NEMA Standards at a maximum ambient temperature of 40 degrees C.

D. Provide electric motors rated for explosion proof service in all electrically classified areas, Class 1 Division 1 or 2, and comply with all requirements of Class 1, Division 1, Groups C&D, as defined by the National Electrical Code, as well as all other safety codes.

E. Unless otherwise indicated, all electric motors shall be premium efficiency type. The nominal or minimum guaranteed efficiency shall be specifically printed on the motor nameplate. The values shall conform to NEMA standards for premium efficiency motors.

2.06 GENERAL DESIGN OF MOTORS

A. Electric motors shall comply with the latest NEMA Standards for Motors and Generators, unless otherwise specified or indicted on the Drawings. Motor windings shall be braced to withstand the stresses resulting from the specific method of starting. The windings shall be treated thoroughly with acceptable insulating compound suitable for protection against moisture, acidic or alkaline conditions. All motor bearings shall be of the self-lubricating type, designed to ensure proper alignment of rotor and shaft and to prevent leakage of lubricant.

B. All bearings for open motors shall be sleeve or ball type, as specified under the respective items of mechanical products and equipment. Bearings for totally enclosed and explosion proof motors shall be ball type. Vertical motors shall be provided with thrust bearings adequate for all potential thrust forces, which could be subjected to the motors during operation.

C. Vertical electric motors of the open type shall be provided with drip hoods of acceptable shape and construction. If the drip hood is too heavy to be easily removed the drip hood shall be designed and constructed with provisions for access for testing.

2.07 WOUND ROTOR INDUCTION MOTORS

A. Wound rotor electric induction motors shall be designed for operation of the motor-driven equipment under the conditions specified in the Contract Documents. Motors shall be wound-rotor, induction type suitable for speed control by rotor resistance. The collector rings shall be constructed of hard composition metal of sufficient conductivity and ample contact surface. The rings shall be mounted accurately and securely on the shaft by means of acceptable insulating construction. The leads to the collector rings shall be fastened to and insulated from the shaft.

B. The collector rings and brushes for the wound-rotor induction motors shall be suitable for operation in atmospheres containing moisture. The brushes shall be of the electrographite type, or other suitable type, of sufficient hardness and conductivity with ample contact surfaces. Brush holders shall be provided with adjustable, spring-tension devices. Brushes shall be connected to the holders with tinned, flexible, copper-wire pigtails so arranged that no appreciable current shall be carried through the sliding contacts or springs. Brushes shall operate without noise or chattering. Rings and brushes shall be located on top of the motor, and shall be easily accessible for inspection and maintenance.

2.08 SYNCHRONOUS MOTORS

A. Synchronous motors shall comply in all respects with the latest NEMA Standards for Motors and Generators, and ANSI Standard C50 for Rotating Electrical Machinery. Synchronous motors shall be designed for operation of the motor-driven equipment under the conditions dictated in the Specifications. The temperature rise shall be based on a cooling temperature not exceeding 40 degrees C and an altitude not exceeding 3,300 feet in the various parts of the motors, when operating continuously at rated voltage, frequency, and power factor, shall conform to the applicable requirements of NEMA Standards.

2.09 SINGLE PHASE MOTORS

A. Unless otherwise indicated, single-phase fractional-horsepower alternating-current motors shall be high efficiency type corresponding to the applications listed in NEMA MG 11 standards.

B. Single-phase motors requiring switching devices and auxiliary starting resistors, capacitors, or reactors shall be furnished as combination units with such auxiliaries either incorporated within the motor housings or housed in suitable enclosures mounted upon the motor frames. Each combination unit shall be mounted upon a single base and shall be provided with a single conduit box.

2.10 INVERTER DUTY MOTORS

A. Electric motors which are rated for inverter duty shall be provided for all applications where used with VFD. All motors shall be suitable for operation over the entire speed range indicated without causing motor overheating at any condition. Forced ventilation type inverter duty rated motors with a separate external continuously operating fan shall not be acceptable. Inverter duty motors installed in a Class 1, Division 1, Groups C&D hazardous, classified locations shall be identified and be specifically designed for variable speed when used in classified locations.

B. Inverter duty motors shall have Class F insulation with a Class B temperature rise and shall be motor nameplated, stamped and labeled as inverter duty rated. All motors shall be designed with a minimum service factor of 1.0. Motors shall be wound with inverter duty wire and phase paper and shall be multi-dipped and baked in polyester, Class H varnish.

C. All inverter duty motors run by VFD shall be equipped with a grounding ring to eliminate VFD induced bearing currents. Permanent magnet direct current (DC) motors shall not require a grounding ring. The grounding ring shall eliminate all destructive electrical currents, which manifest themselves through pitting of the bearings, scoring of the shaft, and eventual bearing failure.

D. When motors are controlled by pulse-width modulation (PWM), VFD; the pulse switching causes high frequency voltage changes (dv/dt), which results in a capacitive induced shaft voltage. These voltages may cause bearing failures and substantially decrease bearing life by electrically discharging through the motor bearings to ground causing pitting and fluting failure. In accordance with NEMA MG 1 standards, the capacitive induced voltage results in peak pulses as high as 10-40 volts from the motor shaft to ground. Mitigation for all inverter duty motor bearing damage shall be provided by shaft grounding brushes, which shall divert all current around the motor bearings.

E. All motors controlled by VFD shall be equipped with a shaft grounding ring kit. The grounding ring kit shall be installed by the motor manufacturer or equipment manufacturer. Each shaft grounding ring (SGR) shall be bolted directly to the motor end bracket or installed with conductive epoxy to ensure ground connection from the grounding ring to the motor frame

F. Provide grounding rings of the same type, style, and duty by a single manufacturer. Acceptable level of quality for inverter duty motor grounding rings: equivalent to AEGIS SGR Bearing Protection Ring.

2.11 DRIVE COUPLINGS

A. All drive couplings shall be all metallic, flexible, and designed for both angular and parallel misalignment. Drive couplings shall be provided with guards and a means for lubrication. Close-coupled connections shall have machined shouldered joints for the motor and pump motor support. High torque couplings shall be all metal gear couplings with external grease fittings. A service factor of 1.50 shall be used based on the motor nameplate rating.

B. Drive couplings for mixers, which differ from the above referenced coupling types, shall be of metallic construction. Couplings shall be standard integral parts of mixer manufacturer's equipment.

2.12 BELT DRIVES

A. All v-belt drives shall be provided with front removable guards.

B. Removing of the guards shall not require disturbing of the sheaves. All belt drive assemblies shall be designed for upsizing and downsizing the sheaving. All belt drives shall be designed for a minimum 1.5 service factor, unless otherwise indicated.

C. Variable-speed transmission in belt drive systems shall consist of a self-contained drive, totally enclosed variable speed motor, a housing on which the motor is mounted and which encloses an adjustable, heavy-duty v-belt drive between two variable-pitch pulleys and the output shaft.

2.13 SCR CONTROLLERS

A. All silicon controlled rectifier (SCR) controllers shall be completely solid state assemblies consisting of an electronic switching amplifier, silicon controlled full wave rectifier, and associated circuitry. Bridge and gate trigger circuitry shall employ printed circuit boards. Provide all required power transformers. All SCR units shall be heavy-duty type suitable for handling the full current rating of the motors and brief acceleration currents. The assembly shall be mounted on a heat sink but insulated there from.

B. Power supply to the SCR controllers shall be 115 volt, single phase, and 60 hertz. Each unit shall be factory wired and tested with all leads brought out to terminal strips to facilitate connections to the motors and local control stations. Each SCR controller shall be designed and constructed with functionality including, but not limited to the following:

1. Full wave rectification

2. Power cube containing all power semi-conductors in a single component

3. Annature contactor with auxiliary normally open and normally closed contacts

4. Circuit breaker to provide overload protection

5. Surge suppressers to protect semi-conductors from line surges and transient voltages

6. Adjustable current limit

7. Adjustable iR compensation

8. Voltage level and current capacities shall meet the requirements of the connected equipment

2.14 GEAR REDUCTION UNITS

A. Gears of gear reduction units shall be manufactured of alloys treated for hardness and rated for severe service duty. All gear reduction units on equipment shall be selected for a minimum Class II service, as classified by the American Gear Manufacturers Association (AGMA).

B. Unless otherwise specified, the complete reduction unit shall be fully enclosed in a heavy cast-iron or fabricated steel housing with gears running in oil. All bearings shall be anti-friction type.

C. The actual and rated horsepower, torque, overhang capacity, or bearing capacity of each reduction unit shall be not less than the horsepower rating of the drive motor, nor less than that which will be encountered under full load or under the most severe loading conditions of the equipment.

D. Unless otherwise specified, all gear reduction units shall be helical or spiral bevel helical combinations. Planetary gear units and worm gear type units shall be used only where specified. Class of service shall be Class II or heavier, as determined by the manufacturer or as directed by the Engineer.

E. The equipment manufacturer shall provide the Engineer with complete, detailed, information, catalog data, design features, loading capacities, and mechanical efficiency ratings for every gear reduction unit incorporated in the Work.

2.15 LUBRICATION FITTINGS

A. All lubrication fittings shall be readily accessible from the outside of all equipment, without the need to remove covers, plates, housings, or guards, or without creating falling hazards by unusual elevations. All lubrication fittings shall be button head type. All lubrication fittings shall be mounted together wherever possible.

B. Pressure grease lubricated fittings shall be Zerk Hydraulic type or Alemite type. Housings of grease-lubricated bearings shall be automatically exhausted to the atmosphere to prevent over-greasing

C. All oil drains shall be piped to a location outside of equipment frames for ease of draining. Provide a 316 stainless steel ball valve for positive shutoff. All drain piping shall be 316 stainless steel tubing.

2.16 SPECIAL TOOLS

A. Each manufacturer shall provide one set of all special tools required to completely assemble, disassemble, or maintain their respective pieces of equipment or systems. Special tools shall refer to oversized or specially dimensioned tools, special attachments or fixtures, or any similar items.

2.17 SPARE PARTS

A. For each piece of equipment furnished, provide spare parts, as specified in the respective sections of Division 40 through 43. All spare parts shall be delivered at the same time as the equipment. Properly store and safeguard such spare parts until completion of the Work, at which time they shall be delivered to the Owner. All spare parts shall be appropriately labeled and shall be properly packaged for long-term storage

2.18 EQUIPMENT DRIVE GUARDS

A. All equipment driven by open shafts, belts, chains, or gears shall be provided with metallic or rigid fiberglass OSHA approved guards enclosing the drive mechanism. Guards shall be securely installed but shall be easily removable with quick open latches. Guards shall be constructed of 2-part epoxy coated sheet steel, epoxy coated steel woven wire, or expanded metal set in a frame of epoxy coated steel members, unless otherwise specified or indicated on the Drawings.

B. All guards shall be secured in position by stainless steel braces or straps, which shall permit easy removal for servicing the respective equipment. All guards shall conform in all respects to all applicable safety codes, OSHA standards, and local Regulations.

2.19 NAMEPLATES

A. Each piece of equipment shall be provided with a 304 stainless steel nameplate, securely fastened in place with 316 stainless steel hardware. All nameplates shall be clearly and permanently inscribed with the manufacturer's name, model or type designation, serial number, principal rated capacities, electrical or other power characteristics, and similar information as appropriate.

B. Nameplates for process chemical storage tanks shall be non-metallic and resistant to the chemical being stored. Chemical storage tank nameplates shall include but are not limited to the following information; manufacturer's name, serial number, rated capacity, name/tag number.

C. An enlarged paper copy of all nameplate data on equipment and motors shall be provided in the submittals as well as the Operation and Maintenance Manuals.

2.20 EQUIPMENT TAG NAMEPLATES

A. Each item of equipment, including all instrumentation, shall have an engraved nameplate bearing the alphanumeric tag number and the descriptive name of the equipment as it is referenced on the Drawings. The nameplate shall be securely affixed in a conspicuous place as approved and directed by the Engineer and Owner. The Contractor shall coordinate the final tag numbers and descriptive names with the Engineer prior to ordering. The Contractor shall install all equipment tag nameplates in a location as directed by the Engineer and Owner.

B. Nameplates shall be resistant to abrasion, heat, and chemicals. Each nameplate shall be manufactured from stain resistant multi-layered acrylic specifically designed for both indoor and outdoor applications. Each nameplate shall be a minimum of 1/16 inch thick, 3-ply, scratch resistant, low glare satin phenolic finish. Nameplates shall conform to Mil Spec LP-387A Type N.D.P. LP 509. The nameplates shall be manufactured of a rigid thermoset material which is electrically non-conductive lamicoid. Provide contrasting background (black) and lettering (white) colors as selected by the Engineer and Owner.

2.21 FASTENERS AND HARDWARE

A. Provide fasteners and hardware as specified. Provide anchor bolts with suitable washers, lock washers and, where required, hexagonal nuts.

B. Fasteners and hardware shall be a minimum of 304-grade stainless steel unless otherwise specified or shown on the Drawings. All fasteners and hardware utilized in submerged applications shall be 316-grade stainless steel. All fasteners and hardware in areas including, but not limited to, the headwork's, dewatering rooms, chemical rooms, process tankage, splitter structures, sludge tanks, equalization tanks, storage tanks, valve vaults, wet wells, etc., shall be 316-grade stainless steel.

C. Expansion bolts shall have stainless steel composition elements of the required number of units and size. All threads shall be clean cut and shall conform to ANSI B 1.1 for Unified Inch Screw Threads (UN and UNR Thread Form).

D. Fasteners and hardware specified to be galvanized, shall be zinc coated, after being threaded, by the hot-dip process in conformity with the latest revisions of ASTM A123 or ASTM A153 standards. Galvanized fasteners and hardware shall only be utilized where specified. Galvanized fasteners and hardware are not considered equal to stainless steel.

E. Anchor bolts and expansion bolts shall be set accurately. If anchor bolts are set before the finished concrete has been placed, they shall be carefully held in suitable templates of Engineer approved design. Where indicated on the Drawings, specified, or as required, anchor bolts shall be provided with square plates at least 4 inches by 4 inches by 3/8 inches or shall have square heads and washers and be set in the concrete forms with suitable pipe sleeves, or both. If anchor or expansion bolts are set after the concrete has been placed, all necessary drilling and grouting or caulking shall be provided by the Contractor, and care shall be taken not to damage the structure or finish by cracking, chipping, spalling, or otherwise during the installation.

F. Fasteners and hardware shall be suitable size for the intended purpose, with direct input from the equipment or product manufacturer. In no case shall anchor bolts have a diameter less than 3/8 inches.

2.22 OILS AND LUBRICANTS

A. Prior to startup and testing, the Contractor shall ensure all motor driven equipment and appurtenances are provided with the appropriate oils and lubricants. The respective equipment manufacturer's shall provide detailed instructions for proper lubrication and oil filling of all products. The use of special or proprietary oils and lubricants shall not be acceptable under any circumstances. All oils and lubricants shall be readily available from a local source within the United States to ensure ease of maintenance for the Owner. Provide oils and lubricants of types and grades as recommended by the respective equipment manufacturers for startup, testing, and initial operation of equipment.

2.23 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSPECTION

A. Inspect receiving structures and anchor supports for defects in workmanship prior to arrival of all equipment. Carefully inspect all equipment for any damage in shipping, defects in workmanship and materials, and tightness of all fastening hardware.

B. Examine all equipment upon delivery for structural soundness, correctness of setting, alignment, and relative arrangement of various parts, adequacy, and correctness of packing, sealing, and lubricants.

C. Prior to startup and testing, ensure motor driven equipment and appurtenances are furnished with the appropriate oils and lubricants. Provide all oils and lubricants in strict accordance with the recommendations of the respective equipment manufacturer.

3.02 FIELD PAINTING OF EQUIPMENT

A. All field painting shall be provided by the Contractor. Provide ferrous metallic and painted surfaces of new or existing equipment and associated appurtenances with a corrosion resistant field applied finished coating system with a coordinated process system color scheme.

B. For retrofit Projects, the color scheme shall match the existing designations for each process system. In all cases, new or retrofit, the color for each process system shall be as directed by the Engineer. Field applied coatings shall be in accordance with Section 09 90 00. Stainless steel, brass, bronze, plastic, and galvanized surfaces shall not be painted unless specifically indicated or directed by the Engineer.

3.03 FACTORY PAINTING

A. The manufacturer's standard factory painting systems shall be provided, unless otherwise specified or indicated on the Drawings. The manufacturer shall provide a certification that the factory painting system applied for equipment located indoors shall withstand 125 hours in a salt-spray fog test. Equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with ASTM B117 standards.

B. Immediately after completion of the testing, the paint shall show no signs of blistering, wrinkling, cracking, or loss of adhesion. The paint shall show no signs of rust creepage beyond 0.125 inches on either side of the scratch mark.

C. The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. All manufacturers' standard factory painting systems shall be designed for the maximum surface temperatures expected to occur on each respective piece of equipment.

3.04 FACTORY PAINTING OF METALLIC SURFACES

A. Clean, pre-treat, prime and paint all metal surfaces. Stainless steel, aluminum, brass, bronze, copper, and plastic surfaces shall not be painted unless specifically indicated in the Contract Documents. Apply all coatings to clean dry surfaces. Clean all surfaces to remove dust, dirt, rust, oil and grease prior to application of paint. Surfaces subject to temperatures in excess of 120 degrees F shall be cleaned to bare metal prior to painting.

B. Where more than one coat of paint is required, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be the manufacturer's standard unless otherwise specified or indicated on the Drawings.

C. All metallic surfaces which are designed to experience temperatures less than 120 degrees F shall receive one coat of epoxy pretreatment primer applied to a minimum dry film thickness of 0.3 mils, one coat of epoxy primer applied to a minimum dry film thickness of 1.0 mils; and two coats of epoxy applied to a minimum dry film thickness of 1.0 mils per coat

D. All metallic surfaces which are designed to experience temperatures between 120 and 400 degrees F shall receive two coats of 400 degrees F heat-resisting epoxy applied to a total minimum thickness of 2.0 mils

E. All metallic surfaces which are designed to experience temperatures greater than 400 degrees F shall receive two coats of 1,000 degrees F heat-resisting epoxy paint applied to a total minimum dry film thickness of 2.0 mils.

3.05 INSTALLATION

A. Install all equipment in accordance with the manufacturer's requirements. Do not install any equipment until all defects or inadequacies in receiving structures have been corrected to meet the design as noted in the Contract Documents. Erect and lubricate all products and equipment in strict accordance with the manufacturer's instructions. Installation shall include providing all oils and grease required for proper operation.

B. All equipment mechanisms shall withstand all stresses that may occur during fabrication, erection, intermittent or continuous operation. The Contractor shall furnish and install all supports as indicated on the Drawings, and as required by the equipment manufacturer.

C. Thoroughly clean all equipment and appurtenant piping to remove all dirt, grease, mill scale, tools, dust, and other foreign matter. The Contractor shall touch up all factory finishes to the satisfaction of the Engineer.

3.06 INSTRUCTION TO OWNER'S PERSONNEL

A. Where specified in other sections, the manufacturer shall furnish the services of competent representatives to give full instruction to the designated Owner’s personnel in the adjustment, operation, and maintenance, pertinent safety requirements of the specified equipment or systems. Instructor’s representatives shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory, controls, electrical requirements, practical operation, and maintenance work.

B. Instruction shall be given during the first regular workweek after the equipment or system has been accepted and turned over to the Owner for regular operation. The number of man-days, (8 hours per day), of instruction furnished shall be as specified for each respective piece of equipment or system. Unless otherwise Specified, approximately half of the time shall be used for classroom instruction. The other half of the time shall be used for field instruction and demonstration with the equipment or system.

C. When significant changes or modifications in the equipment or system are made under the terms of the Contract, the manufacturer shall provide additional instruction to acquaint the operating personnel with the changes and modifications to the equipment or system. Additional instruction shall be at no cost to the Owner.

D. Unless approved by the Engineer and Owner, only one Startup, Testing, or Training session shall be scheduled in a single day. A minimum of 72 hours of prior notice shall be provided prior to testing and training.

3.07 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.08 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.09 CLOSEOUT ACTIVITIES

Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 40 05 13

PROCESS PIPE AND FITTINGS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide all labor, materials, equipment, incidentals, and appurtenances required for process pipe and fittings in accordance with this Section and applicable reference standards listed in Article 1.03.

2. The following sections reference the process piping and specification reference numbers shown in the piping tag symbols on the Drawings. Pipes without pipe tag symbols are specified elsewhere. The piping included in this Specification may or may not all be required for the Work. Provide pipe that is specified, indicated on the Drawings or required to complete the work.

3. Furnish, install, test and make ready for operation all process pipe and fittings of the type(s) and size(s) required as shown on the Drawings and as specified. Provide all related appurtenances, including but not limited to attachments, foundations, anchors, supports, couplings, restraints and all related accessories to provide complete operational piping systems as shown on the Drawings and as specified.

B. Related Requirements

1. Section 09 90 00 – Painting and Coating

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. ASME International (ASME)

a. ASME A13.1 Scheme for the Identification of Piping Systems

b. ASME B1.1 Unified Inch Screw Threads (UN and UNR Thread Form)

c. ASME B1.20.1 Pipe Threads, General Purpose (Inch)

d. ASME B16.1 Cast Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250

e. ASME B16.3 Malleable Iron Threaded Fittings Classes 150 and 300

f. ASME B16.9 Factory-Made Wrought Buttwelding Fittings

g. ASME B16.15 Cast Bronze Threaded Fittings Classes 125 and 250

h. ASME B16.18 Cast Copper Alloy Solder Joint Pressure Fittings

i. ASME B16.21 Nonmetallic Flat Gaskets for Pipe Flanges

j. ASME B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

k. ASME B16.26 Standard for Cast Copper Alloy Fittings for Flared Copper Tubes

l. ASME B31.1 Power Piping

m. ASME B31.9 Building Services Piping

2. ASTM International (ASTM)

a. ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

b. ASTM A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

c. ASTM A181 Standard Specification for Carbon Steel Forgings, for General-Purpose Piping

d. ASTM A193 Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service

e. ASTM A197 Standard Specification for Cupola Malleable Iron

f. ASTM A234 Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service

g. ASTM A240 Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels

h. ASTM A269 Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

i. ASTM A276 Standard Specification for Stainless Steel Bars and Shapes

j. ASTM A307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength

k. ASTM A312 Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes

l. ASTM A351 Standard Specifications for Castings, Austenitic, for Pressure-Containing Parts

m. ASTM A380 Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems

n. ASTM A403 Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings

o. ASTM A479 Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels

p. ASTM A530 Standard Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe

q. ASTM A536 Standard Specification for Ductile Iron Castings

r. ASTM A632 Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing (Small-Diameter) for General Service

s. ASTM A733 Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples

t. ASTM A774 Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures

u. ASTM A778 Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products

v. ASTM B117 Standard Practice for Operating Salt Spray (Fog) Apparatus

w. ASTM B61 Standard Specification for Steam or Valve Bronze Castings

x. ASTM B62 Standard Specification for Composition Bronze or Ounce Metal Castings

y. ASTM B88 Standard Specification for Seamless Copper Water Tube

z. ASTM B124 Standard Specification for Copper and Copper Alloy Forging Rod, Bar, and Shapes

aa. ASTM C150 Standard Specification for Portland Cement

bb. ASTM D1238 Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer

cc. ASTM D1248 Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable

dd. ASTM D1598 Standard Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure

ee. ASTM D1599 Standard Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings

ff. ASTM D1784 Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

gg. ASTM D1785 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

hh. ASTM D2000 Standard Classification System for Rubber Products in Automotive Applications

ii. ASTM D2239 Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter

jj. ASTM D2467 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

kk. ASTM D2564 Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems

ll. ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials

mm. ASTM F1476 Standard for Performance of Gasketed Mechanical Couplings in Piping Applications

nn. ASTM F402 Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings

oo. ASTM F439 Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80

pp. ASTM F441 Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80

qq. ASTM F493 Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings

rr. ASTM F593 Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

ss. ASTM F594 Standard Specification for Stainless Steel Nuts

3. American Water Works Association (AWWA)

a. AWWA C104/A21.4 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water

b. ANSI/AWWA C110/A21.10 Ductile-Iron and Gray-Iron Fittings, 3 in through 48 in (76 mm through 1219 mm), for Water

c. ANSI/AWWA C111/A21.11 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

d. AWWA C115/A21.15 Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges

e. AWWA C150/A21.50 Thickness Design of Ductile-Iron Pipe

f. AWWA C606 Grooved and Shouldered Joints

g. AWWA M 11 Steel Water Pipe: A Guide for Design and Installation

4. International Organization For Standardization (ISO)

a. ISO 228-1 Pipe Threads Where Pressure-Tight Joints Are Not Made on the Threads - Part 1: Dimensions, Tolerances and Designation

5. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)

a. MSS SP-58 Standard for Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation

b. MSS SP-89 Pipe Hangers and Supports - Fabrication and Installation Practices

c. MSS SP-69 Standard for Pipe Hangers and Supports - Selection and Application

6. NSF International (NSF)

a. NSF 61 Drinking water System Components – Health Effects

b. NSF 372 Drinking Water System Components – Lead Content

7. Underwriters Laboratories (UL)

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Shop Drawings

1. Shop Drawings for each type of process pipe shall be identified with the applicable style or series designation. Shop drawings shall show layout and dimensions of equipment, major components, key alignment locations and locations of bolt holes. Drawings shall show critical field dimensions identified by the manufacturer.

2. Shop Drawings shall show layouts and dimensions of the piping, including actual pipe lengths, diameters, fittings and appurtenances.

C. Product Data

1. Submit sufficient product data to verify compliance with the specifications and to illustrate the construction and assembly of the products. Include compliance of materials and components with applicable standards. Product data shall include manufacturer's descriptive data, technical literature, performance charts, catalog cuts, and installation instructions.

2. Prior to shipment of pipe, submit a certified affidavit of compliance from the pipe manufacturer stating that the pipe, fittings, gaskets, linings and exterior coatings for this Project have been manufactured and tested in accordance with applicable AWWA, ASTM and other standards as well as the requirements specified.

D. Reports

1. Submit field test reports for each section of piping tested for pressure and leakage.

E. Closeout and maintenance material submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. All welding shall be conducted under qualified welding procedures. All welders and operators shall be certified in accordance with the latest applicable AWS and ANSI codes for shop and Project Site welding of piping work. Furnish written proof of certifications upon request from the Engineer.

1.07 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. All equipment delivered and placed in storage shall be provided with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants in accordance with the Manufacturer's written instructions.

C. Finished surfaces of all exposed openings shall be protected by caps, wooden blanks or other suitable cover to prevent foreign material and debris from entering the equipment.

D. Off-load equipment at the installation site using equipment of sufficient size and design to prevent damage to the equipment. Immediately after off-loading, inspect all equipment for shipping damage or missing parts. Any damage or discrepancy shall be noted in a written claim with the shipper prior to accepting delivery. Validate all serial numbers and parts lists with the shipping documentation. Notify the manufacturer of any unacceptable conditions with the shipper. Pipe which has been rejected after delivery shall be specifically marked for non-use and shall be removed from the Project Site at no additional cost to Owner. The acceptance of manufacturer's pipe samples prior to shipment shall not guarantee acceptance of all subsequent piping delivered to the job Site.

E. Where necessary to store outside, enclose with durable, waterproof wrapping. Store rubber products under cover out of direct sunlight. Do not store materials directly on the ground.

F. Plastic pipe shall be packed, packaged, and marked in accordance with ASTM D3892. A Material Safety Data Sheet (MSDS) in conformance with 29 CFR 1910 Section 1200(g) shall accompany each chemical product delivered for use in pipe installations. At a minimum, this includes all solvents, solvent cements, glues and other materials that may contain hazardous compounds. Handling of chemicals for piping installation shall be in accordance with ASTM F402.

G. Stacking & Unloading

1. Unload all piping in strict accordance with the manufacturer's recommendations. Take care not to damage the pipe during unloading. Utilize padding on all hooks, slings, and pipe tongs used for unloading to prevent damage to the piping including exterior coating and interior lining. Damage to the interior lining of piping shall render it unfit for use. Dropping of pipe during unloading is not acceptable. Care shall be taken to not skid piping against stationary piping during unloading or stacking.

2. All piping shall be stacked in accordance within the limits recommended by its manufacturer. The piping shall be supported off the ground through the use on timbers, rails, or concrete as recommended by the piping manufacturer.

3. Avoid contact between stainless steel piping and ferrous surfaces or materials, which may lead to rusting of particles embedded in the walls of stainless steel piping. All stainless steel piping shall be stored on supports constructed of non-ferrous metal materials. All tools for stainless steel piping installation shall be specifically designated for use on stainless steel piping to ensure no contamination from ferrous metals occurs. All piping storage and fabrication supports shall be constructed from non-ferrous metal, stainless steel, or provided with a rubber lining.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 GENERAL

A. All piping systems, components, and appurtenances in contact with potable water including potable water during any stage of treatment or conditioning shall be certified to meet the requirements of NSF 372 and NSF 61 for water service.

B. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components. All castings used for fittings and couplings shall be date stamped for quality assurance and traceability.

2.02 DUCTILE IRON PIPE & FITTINGS - TYPE (DI/1)

A. All Type (DI/1) ductile iron piping shall be minimum special thickness class 53 flanged pipe and fittings per AWWA C150/A21.50, AWWA C115/A21.15, and AWWA C110/A21.10. Flanges shall conform to the drilling and facing of ASME B16.1/ANSI Class 125 unless otherwise noted or as required to connect to valves, tanks, equipment, and other appurtenances.

B. All flanged pipe joints shall be assembled using gaskets. All pipes shall be provided and installed in standard lengths whenever possible.

C. Provide Type (DI/1) ductile iron pipe of the same type, style, and duty supplied by a product of one of the following manufacturers.

1. U.S. Pipe & Foundry Company Inc.

2. American Cast Iron Pipe Company

3. Clow Water System Company

4. Or equal

D. Flanges & Connectors

1. All ductile iron flanges shall conform to ANSI/AWWA C115/A21.15 and be flat faced type unless otherwise specified or indicated on the Drawings. All ductile iron fittings shall conform to ANSI/AWWA C110/A21.10 standards and be pressure rated for 250 psi. As a minimum, all fittings shall be rated equally to the connecting piping.

2. Unless otherwise specified or indicated on the Drawings, all ductile iron piping and fittings shall utilize ANSI standard flanged connections.

E. Interior Linings

1. Interior Coating – Ceramic Epoxy lining equivalent level of quality: Protecto 401 Ceramic Epoxy Lining.

F. Exterior Coatings

1. An exterior coating shall be provided for all ductile iron pipe, fittings, and flanges. Unless otherwise specified or noted on the Drawings, the prime coat shall be factory applied. The top coat (finished coat) shall be field applied as approved by the Engineer. The top coat shall match the color coding for the material to be handled by the pipe. All field finish painting shall be in accordance with Section 09 90 00.

2. Unless approved in writing by the Engineer the finished coat shall be applied prior to assembly of the pipe in moist areas. Stainless steel flange hardware shall not be painted with epoxy paint.

3. Submerged piping shall not require a urethane finish.

4. The pipe shall not be coated at pipe and fitting ends to allow for Engineer approved installation of joint connections in the field. The pipe manufacturer shall provide all necessary coating materials for application at factory supplied uncoated piping locations. All field applied coatings shall be a product of the same manufacturer as the factory prime coating to ensure compatibility. All flange bearing surfaces shall be left uncoated.

5. Field repair of damaged pipe coatings shall receive prior written approval by the Engineer. If the Engineer deems the coating damage to be beyond repair, all damaged piping shall be replaced at no additional cost to the Owner or the Engineer.

G. Flange Hardware

1. All nuts, bolts, washers and other flange or coupling fastening hardware shall be of a material as specified below. Threads shall be coated with mineral oil or other anti-seize compound. Bolts shall be square headed machine bolts with hexagonal nuts in accordance with ANSI B18.2. All threads shall conform to ANSI B1.1. The bolts shall be of an adequate length such that they protrude through the nut following tightening. The bolt protrusion shall not exceed 1/2 inch.

H. Pipe Markings

1. All ductile iron pipe and fittings as specified in this section shall be permanently marked with the manufacturer, date of manufacture, size, type, class, wall thickness, and standard produced to (ASTM, AWWA, ANSI).

I. Non-Standard Fittings

1. Fittings with non-standard dimensions shall only be allowed with prior written approval of the Engineer. Unless approved in writing by the Engineer, all non-standard fittings shall meet the Specification requirements for standard fittings and be of the same thickness and diameter. Laterals or reducing elbows not meeting the requirements of ANSI A21.10 shall meet the requirements of ANSI B16.1, Class 125.

J. Joint Bracing

1. Provide joint bracing as shown on the Drawings and as required to prevent piping from being pulled apart when under pressure. If used, all bridles and tie rods shall be a minimum of 3/4 inches in diameter except when they replace flange bolts of a smaller size. If replacing flange bolts of a smaller size, the bridles shall be fitted with a nut on each side of the pair of flanges.

2. All pipe which requires joint bracing shall be provided with Engineer approved lugs and hooks cast integrally for use with pipe clamps, tie rods, or bridles. All pipe clamps, tie rods, and bridles shall be provided with the same coating as the piping system for interior applications except that stainless steel hardware shall not be painted.

2.03 GASKETS

A. Gaskets shall conform to ANSI/AWWA C111/A21.11. Gaskets shall be provided by the pipe manufacturer unless otherwise noted. Unless otherwise noted, all gaskets 12 inches in diameter or less shall be a minimum of 1/8 inches thick. All gaskets larger than 12 inches in diameter shall be a minimum of 3/32 inches thick.

B. Gaskets to have a smooth finish, be designed for use in plastic, metal or plastic-lined metal piping systems as applicable and be compatible with the associated process fluid. Gaskets for use in potable water service shall have an NSF 61 listing. Gaskets for low pressure air piping shall be suitable for use at temperatures to 250 degrees F.

C. Gaskets for use on flanged piping shall be low torque, flat ring type, full face to ANSI B16.5 dimensions for 125/150-pound flanges and rated for a minimum pressure of 150 psi. Gaskets shall have two concentric, convex, molded rings between the center hole and bolt hole circle. For flanged CPVC piping, when the mating flange has a raised face an additional filler gasket shall be provided between the outer diameter of the raised face and outer diameter of the flange to protect the flange from bolting moments.

D. Gaskets for use on mechanical joint and push-on joint piping shall meet or exceed the minimum requirements of AWWA C111/A21.11 for styrene-butadiene rubber (SBR) gaskets. Gaskets for use on bell and spigot joint FRP piping shall be EPDM.

E. Gaskets for use with grooved end joints shall be pressure responsive elastomer. Gaskets for carbon steel grooved end piping shall be EHP and suitable for water service to 250 deg F. Gaskets for HDPE grooved end piping to be pre-lubricated.

F. If for a specific application a pipe or valve manufacturer recommends a different type of gasket than that specified, submit gasket information Engineer the for review and approval.

G. Provide gaskets constructed of the following materials for process fluids and chemical piping systems as shown on the Drawings:

1. Aluminum Sulfate: EPDM
2. Citric Acid: Viton
3. Ferric Chloride: EPDM
4. Ferrous Chloride: EPDM
5. Grit Slurry: Hypalon or Neoprene
6. Low Pressure Air or Vents: EPDM
7. Oil or Gasoline: NBR (Buna-N)
8. Sodium Bisulfite: Viton
9. Sodium Hydroxide (Caustic Soda): EPDM
10. Sodium Hypochlorite: Viton
11. Sulfuric Acid: Viton
12. Wastewater or Sludge (Interior/Below Grade): Nitrile
13. Wastewater or Sludge (Exterior/Above Grade): EPDM

H. Gaskets of the same type and material to be provided by a single manufacturer. Gaskets to be a product of one of the following manufacturers.

1. Asahi America, Inc.
2. Allstate Gasket & Packing, Inc.
3. Metro Industries, Inc.
4. Or equal

2.04 UNIONS

A. When joining pipe segments, provide unions where called for on the Drawings and as specified. Provide additional unions to allow for disassembly of piping segments. Provide unions at pumps, equipment and valves to allow for removal without disassembly of the piping systems.

B. Unions or flanges for servicing and disconnect are not required in installations using grooved joint couplings.

2.05 PIPE AND FITTINGS COATINGS

A. An exterior coating shall be provided for all ferrous metallic pipe, fittings, and flanges. The prime coat shall be factory applied. The finish coat shall be field applied. The finish coat may be factory applied for all submerged piping applications. The finish coating color shall match existing color coding for retrofit or upgrade Projects. For new Projects and systems, the color coding shall be as directed by the Engineer.

B. The color coding shall be unique color for each fluid carried. Fluid designations are provided on the Drawings. The Engineer and Owner shall determine colors for each application.

C. Unless otherwise indicated, all ferrous metallic pipe shall be field finish painted. Refer to Section 09 90 00 as well as the piping manufacturer's recommendations for coating types and requirements. Coat ferrous metallic pipes, fittings, hangers and supports using the same paint system. Stainless steel pipe, stainless steel pipe supports, stainless steel hardware and appurtenances shall not be painted. All ferrous metallic pipe in submerged applications does not require a urethane finish. The finished coating shall be a product of the same manufacturer as the prime coat to ensure compatibility.

D. Confirm the final color-coding with the Owner and Engineer prior to any application.

2.06 ATTACHMENT HARDWARE

A. Unless otherwise indicated, all attachment hardware, including but not limited to nuts, bolts, washers and all related fastening devices shall be 316 stainless steel. Threads shall be coated with mineral oil or another anti-seize compound prior to installation. Hardware for submerged applications shall be 316 stainless steel.

2.07 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements. Comply with applicable reference standards listed in Article 1.03.

PART 3 – EXECUTION

3.01 INSTALLATION - GENERAL

A. Piping systems shall be fabricated and installed in accordance with ASME B31.1. Install each run of piping with minimum joints and couplings, but with adequate and accessible unions for disassembly and maintenance or replacement of valves and equipment. Reduce sizes, where indicated on the Drawings, by use of reducing fittings. Align piping accurately at connections, within 1/16-inch misalignment tolerances.

B. Locate piping runs, except as indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown, or, if not otherwise indicated, run piping in the shortest route which does not obstruct usable space or block access for servicing the building and its equipment. Hold piping close to walls, overhead construction, columns, and other structural and permanent-enclosure elements of buildings.

C. Horizontal piping shall pitch uniformly 1 inch in 40 feet and drain to a minimum number of low points. All low points shall be provided with a minimum 3/4-inch tapped Type SS/2 drain pipe, 304 stainless steel isolation ball valve (Type V26), and 304 stainless steel or aluminum hose connection.

D. Provide unions in piping as shown on the Drawings and as specified. Unions shall be provided in locations, including but not limited to the following: equipment, pumps, tanks, valves, long piping runs, piping bypasses around equipment, or any other location as directed by the Engineer or Owner. Unions shall be located to allow for piping disassembly, alterations, and repairs.

E. Provide field routing and coordination of process piping routing as required to accommodate all necessary coordination with other Work, including, but not limited to heating, ventilating, and air-conditioning (HVAC), electrical, structural, architectural, plumbing, and civil work.

F. Unless otherwise indicated, provide concrete thrust blocks at all pipe fittings and changes in direction or alignment. For clarity, thrust blocks may or may not be shown at every bend, fitting, or directional change.

G. Grooved joints shall be installed in accordance with the manufacturer’s latest published instructions. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service. Gaskets shall be molded and produced by the grooved coupling manufacturer. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove.

3.02 DUCTILE IRON PIPE INSTALLATION - TYPE (DI/1)

A. Install Type DI/1 ductile iron piping and fittings true to alignment. Provide rigid pipe supports and anchorage. All pipe shall be thoroughly cleaned prior to laying and shall be kept clean throughout the duration of the Work. Provide all fittings for field routing of piping in addition to those shown on the Drawings to provide for a complete and operational piping system. Provide additional flanges as directed by the Engineer where piping interferes with existing facilities. All ductile iron piping and fittings shall be installed in accordance with requirements of AWWA C600.

B. The support spacing shall be in strict accordance with the recommendations of the piping manufacturer. The installation and piping support system shall not allow deflection of piping greater than 50 percent of the maximum deflection as recommended by the piping manufacturer. Each section of piping and fittings must be cleaned, free of dirt, debris and other foreign material prior to installation. All cleaning shall be in accordance with the recommendations of the piping manufacturer.

C. Pipe Cutting

1. Pipe cutting shall be as approved by the Engineer. Any damage to the interior pipe linings shall be repaired to the satisfaction of the Engineer before installation. If approved by the Engineer, cutting shall be conducted using a saw with blades specifically designed for cutting iron pipe. All cuts shall be at right angles to the axis of the piping. The cuts shall leave smooth edges. Damages to interior pipe linings caused by cutting of pipe shall be repaired to the satisfaction of the Engineer and Owner.

2. Seal the ends of all cut pipe in accordance with the recommendations of the pipe manufacturer.

3. Field cutting and threading of ductile iron pipe is not acceptable under any circumstances. All pipe shall be pre-cut and threaded for flanges at the factory of origin.

D. Joints & Connections

1. Connect piping to equipment in accordance with the instructions of the equipment manufacturer. When manufacturers indicate that equipment shall not support dead loads from piping, submit, in writing, that the piping installation does not transfer loading from the piping to the equipment, and that all the manufacturer's requirements have been met. Install piping so as not to impart any strain or loading on the connected equipment

2. All bolts for flanged joints shall be tightened evenly. All bolts shall conform to the size of the flange and well as all ANSI standards. Flanged joints shall be made using gaskets, bolts, and bolt studs with a nut on each end. Utilize studs with nuts where the flange is tapped.

3. Provide tapped pipe connections as shown on the Drawings and as directed by the Engineer. All piping shall be drilled and tapped perpendicular to the longitudinal access of the pipe. All taps shall be designed to seal watertight. The pipe taps shall be of sufficient strength to prevent blowouts in pressurized applications. Follow the manufacturer's instructions when tapping into fittings. All pipe taps shall be in accordance with ANSI A21.51.

3.03 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 40 05 15

PROCESS PIPE SUPPORTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide labor, materials, equipment, incidentals, hardware and appurtenances to install a complete system of pipe hangers, pipe supports, concrete inserts, anchor bolts and related appurtenances for supporting non-buried piping as shown on Drawings and as specified. All pipe hanger and support systems shall be designed and constructed to resist the seismic forces as specified or as indicated on the Drawings.

B. Related Requirements

1. Section 09 90 00 - Painting and Coating

2. Section 40 05 13 - Process Pipe and Fittings

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)

a. MSS SP-58 Standard for Pipe Hangers and Supports - Materials, Design and Manufacture

b. MSS SP-69 Standard for Pipe Hangers and Supports – Selection and Application

c. MSS SP-90 Guidelines on Terminology for Pipe Hangers and Supports

2. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

a. Seismic Restraints Manual

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: Per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Shop Drawings

1. Submit complete piping layout Drawings for each piping system. Indicate the type and locations of hangers, supports, anchors, guides, anchor bolts, and any other pipe supporting appurtenances.

2. Where standard hangers and/or supports are not suitable, submit detailed Drawings showing materials and methods of construction for each type of custom hanger and support.

3. Submit detailed Drawings any construction-related deviations in piping layouts, materials or routing. The review of construction-related deviation submittals shall only be for conformance to the Specifications and Drawings.

C. Product Data

1. Submit catalog cuts, Specifications and dimensioned Drawings for each type of pipe hanger and support.

2. Indicate materials of construction, important dimensions and range of pipe sizes for which each hanger is suitable.

3. Submit detailed information on anchor bolts, hardware, anti-seize compounds, and any other appurtenant materials.

4. The product data shall include a representative catalog cut for each different type of pipe hanger or support indicating the materials of construction, important dimensions and range of pipe sizes for which that hanger is suitable. Where standard hangers and/or supports are not suitable, submit detailed drawings showing materials and methods of construction for each type of special hanger and/or support.

5. Include design calculations of support reactions transmitted to the structure and type of anchor, guide and other pipe supporting appurtenances including structural fasteners.

D. Closeout and maintenance material submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. The fabricator of pipe hangers, supports and related appurtenances shall have not less than 5 years of current experience in the design and fabrication of the pipe hangers and supports as specified in this section.

C. Provide pipe hangers and supports which comply with the Manufacturers Standardization Society of the Valve and Fittings Industry (MSS), MSS SP-58 standards. Select and apply pipe hangers and supports, complying with MSS SP-69 standards. Terminology in this Specification is defined in MSS SP-90 standards.

D. All piping hangers, supports and appurtenances shall conform to the latest applicable requirements of the State Building Code of the Project location and ANSI B31.1, except as supplemented or modified by the requirements of this Specification.

E. Coordinate process piping hangers, supports, and appurtenances to eliminate interference with similar support systems to be installed for plumbing, heating, ventilating, and air conditioning (HVAC), electrical, and other disciplines of Work. The piping support systems shall account for structural expansion joints and co-located piping expansion joints. The piping hanger and support system shall provide and maintain unhindered access to all equipment for both operation and removal. No material handling equipment supports shall be used for piping supports. Do not attach piping hangers, supports, and appurtenances from structural struts or braces unless approved in writing by the Engineer.

F. All process piping and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain or force from being imposed on the equipment. When the equipment manufacturers have indicated that piping loads shall not be transmitted to their equipment, submit a written certification stating that such requirements have been complied with.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 PIPING SUPPORTS - GENERAL

A. The products specified are intended to support the various types of process piping systems shown on the Drawings. The Contractor shall be responsible for developing the final details associated with the specific installation conditions. The details include, but are not limited to, piping system temperatures and pressures associated with each application.

B. The Contractor may propose minor adjustments to the piping arrangements to simplify the supports and to adjust the layout of process piping systems. An example of an adjustment shall be a minor change to a pipe centerline elevation so that a single trapeze support may be used for a process piping system.

C. Unless otherwise indicated, process piping hangers and supports shall be a manufacturer's standard product. All products specified or otherwise shall conform to the requirements of MSS SP-58 and MSS SP-69 standards. Any reference to specific catalog or figure numbers from a specific manufacturer shall be for establishing the type, design, and quality of a piping support product. Any references contained in this Specification section shall not be considered as proprietary.

D. All piping supports and hangers of the same type, style, and duty shall be supplied by a single manufacturer. All process piping supports and hangers shall be a product of the following manufacturer:

1. Gulf States Hangers & Supports Manufacturers, Inc.
2. Anvil International, Inc.
3. Carpenter & Paterson, Inc.
4. Eaton B-Line (Formerly Cooper B-Line)
5. PHD Manufacturing, Inc.
6. Unistrut Corporation (For Pipe Support Framework)
7. Globe Strut (For Pipe Support Framework)
8. Power-Strut (For Pipe Support Framework)
9. MP Husky (For Pipe Support Framework)
10. Or equal

2.02 PIPING FORCES

A. Provide ridged support of all piping systems. Provide supports to prevent significant stresses in the material, valves, fittings and other connected pipe appurtenances. All supports and anchors shall be designed to secure the pipe in the intended position and alignment.

B. All supports and anchors shall be designed to accommodate thermal expansion and contraction.

C. Pipe supports and anchor design shall specifically account for internal flow forces, all probable external forces from equipment connection, human contact, and all seismic forces. Provide structural steel members to brace any piping system from excessive dislocation. All pipe fittings and appurtenances connected to equipment shall be supported in a manner to prevent any strain from being imposed on the equipment or piping systems. All pipe supports shall be installed such that they do not induce point loadings on the piping. All supports shall distribute pipe loads evenly along the pipe circumference.

D. All piping hangers, supports and appurtenances shall be adequate to maintain the supported load in proper position under all operating conditions. The minimum working factor of safety for all supporting equipment, except for springs, shall be 1/5 the ultimate tensile strength of the material, assuming a minimum 10 feet of water filled pipe being supported.

2.03 DISSIMILAR METALS

A. All stainless steel piping shall be isolated from all ferrous metals including galvanized steel. Provide a neoprene sheet or stainless steel protection shields to prevent direct contact when installed.

B. Copper piping shall be protected from galvanic corrosion from contact with ferrous metals. Provide corrosion protection by wrapping the copper pipe with 1/16-inch thick neoprene, sheet metal and a galvanized protection shield with isolators. Copper plated or polyvinyl chloride (PVC) coated hangers and supports may also be used to provide dielectric isolation.

2.04 NON-METALLIC PIPING

A. Uninsulated non-metallic piping, including, but not limited to Type (PVC/1), Type (PVC/3), Type (PVC/4) and Type (PE/1), shall be protected from local stress concentrations at each support point. Protection from local stresses shall be provided by PVC coated steel or 304 stainless steel protection shields.

B. Pipes which are bottom supported for 180 degrees shall be provided with arc shields. Pipes which are supported for 360 degrees shall be provided with protection shields for the entire exterior pipe circumference. Protection shields shall have an 18-gauge minimum thickness. Protection shields shall be a minimum of 12 inches in length. Securely fasten each protection shield to the pipe with 304 stainless steel straps not less than 1/2 inches in width.

2.05 INSULATED PIPE

A. Insulated piping shall be provided with a rigid insulating saddle at each pipe support location. Provide protection shields at each support location.

2.06 VERTICAL PIPING

A. Whenever possible, support vertical piping using floor supports rather than wall supports. Concrete supports, base elbows, and base tees shall be used when possible and as shown on the Drawings.

B. Support vertical piping by pipe collars, clamps, brackets, or wall rests. Spacing as indicated under “Support Spacing” in this Specification.

C. All vertical pipes passing through pipe sleeves shall be secured using a pipe collar.

2.07 MATERIALS OF CONSTRUCTION

A. All piping support systems shall be constructed of the following materials based on location unless otherwise specified or indicated on the Drawings

1. All submerged piping: 316 stainless steel

2. All outdoor piping: 316 stainless steel

3. All interior in-basin, in-channel, as well as piping in access vaults (located above the maximum water level): 304 Stainless Steel

B. All pipe clamps on plastic pipe shall be provided with a plastic coating or neoprene isolator.

C. All supports for copper pipe shall be copper plated or shall have a minimum 1/16-inch plastic coating.

D. All fasteners and related hardware for supports, including, but not limited to nuts, bolts, anchors, and washers shall be 316 stainless steel regardless of location.

E. All stainless steel components shall be passivated after fabrication.

2.08 HORIZONTAL PIPING HANGERS AND SUPPORTS

A. Unless otherwise specified or indicated on the Drawings, provide factory fabricated horizontal piping hangers and supports conforming to MSS SP-58 standards. Horizontal piping supports and hangers shall be one of the following MSS types listed below.

1. The specific type of support shall be selected to suit the horizontal piping system layout in accordance with MSS SP-69 standards as well as the piping manufacturer's published support requirements. Whenever possible, use only one type of support system by one manufacturer for each piping service. Select the size of hangers and supports to exactly fit the nominal pipe outside diameter for bare piping, and to exactly fit around piping insulation with a saddle or shield for all insulated piping.

2. Type 5 - Pipe Hangers, Type 12 - Pipe Clamps, and Type 26 - Pipe Clips shall not be used. Type 3 - Three Bolt Pipe Clamps shall not be used on insulated piping systems. Type 24 - U-Bolts shall only be used in conjunction with other supports types including trapeze hanger systems or fabricated frames.

2.09 SINGLE PIPE CLEVIS HANGERS

A. Whenever possible, single process piping runs shall be supported by single pipe adjustable clevis type hangers (MSS Type 1), suspended by hanger rods from structural steel members, concrete ceilings, or the bottom of trapeze hangers. The clevis type hanger shall be specifically designed for the process piping type being supported as follows

1. Adjustable Clevis Hangers

   a. Anvil International, Inc. - Figure No. 260

   b. Carpenter & Paterson, Inc. - Figure No. 100

   c. PHD Manufacturing, Inc. - Figure No. 425

   d. Or equal

2. Adjustable Clevis Hangers (Insulated Pipe)

   a. Anvil International, Inc. - Figure No. 300

   b. Carpenter & Paterson, Inc. - Figure No. 100EL

   c. PHD Manufacturing, Inc. - Figure No. 430

   d. Or equal

3. Adjustable Clevis Hangers (Cast Iron or Ductile Iron Pipe)

   a. Anvil International, Inc. - Figure No. 590

   b. Carpenter & Paterson, Inc. - Figure No. 100DI

   c. PHD Manufacturing, Inc. - Figure No. 420

   d. Or equal

2.10 PIPE CLAMPS

A. Single process piping runs supported by pipe clamps, (MSS Type 4), shall be in accordance with the following

1. Anvil International, Inc. - Figure No. 212

2. Carpenter & Paterson, Inc. - Figure No. 175

3. PHD Manufacturing, Inc. - Figure No. 520/521

4. Or equal

2.11 ADJUSTABLE BAND HANGERS

A. Single process piping runs supported by adjustable band hangers, (MSS Type 7), shall be in accordance with the following

1. Carpenter & Paterson, Inc. - Figure No. 1A

2. PHD Manufacturing, Inc. - Figure No. 180, 181, & 183

3. Or equal

2.12 PIPE SADDLE SUPPORTS

A. Single process piping runs supported by pipe saddle supports, (MSS Type 36), shall be in accordance with the following

1. Anvil International, Inc. - Figure No. 258

2. PHD Manufacturing, Inc. - Figure No. 880

3. Or equal

B. Provide pipe base supports and cast floor flanges for all pipe saddle supports. Refer to the details on the Drawings for additional requirements.

2.13 PIPE STANCHION SADDLES

A. Single process piping runs supported by pipe stanchion saddles, (MSS Type 37), shall be in accordance with the following

1. Anvil International, Inc. - Figure No. 259
2. Carpenter & Paterson, Inc. - Figure No. 125
3. PHD Manufacturing, Inc. - Figure No. 882
4. Or equal

B. Provide pipe base supports and floor flanges for all pipe stanchion saddles. Refer to the details on the Drawings for additional requirements.

2.14 ADJUSTABLE ROLLER HANGERS

A. Single process piping runs supported by adjustable roller hangers (MSS Type 43), shall be in accordance with the following

1. Anvil International, Inc. - Figure No. 181
2. Carpenter & Paterson, Inc. - Figure No. 140
3. PHD Manufacturing, Inc. - Figure No. 470 & 475
4. Or equal

2.15 PIPE ROLL STANDS

A. Single process piping runs supported by pipe roll stands, (MSS Type 44), shall be in accordance with the following:

1. Anvil International, Inc. - Figure No. 271
2. Carpenter & Paterson, Inc. - Figure No. 54
3. PHD Manufacturing, Inc. - Figure No. 486
4. Or equal

2.16 PIPE ROLLS & PLATES

A. Single process piping runs supported by pipe rolls and plates, (MSS Type 45), shall be in accordance with the following:

1. Anvil International, Inc. - Figure No. 277
2. Carpenter & Paterson, Inc. - Figure No. 63

3. Or equal

2.17 PIPE GUIDES & SLIDE PLATES

A. Provide structural slide assemblies and guides (MSS Type 35) using reinforced polytetrafluoroethylene (PTFE) or graphite slides to allow for longitudinal pipe movement. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints shall be provided as needed. Where slides do not require provisions for lateral restraint the following methods may be used

1. For piping systems 4 inches and larger, when the temperature of the medium is 60 degrees F or higher, a pipe covering protective saddle (MSS Type 39) which is welded to the pipe may freely rest on the support.

2. For piping systems less than 4 inches, a pipe protection shield (MSS Type 40) attached to the pipe or insulation, may freely rest on the support.

3. For piping systems 4 inches and larger carrying medium less than 60 degrees F, a pipe protection shield (MSS Type 40) attached to the pipe or insulation, may freely rest on the support.

B. In cases where there are high system temperatures and welding to piping is not desirable, pipe slide assemblies and guides shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches or by an amount adequate for the insulation, whichever is greater.

C. Except as otherwise indicated, provide factory fabricated pipe guides and slide plate systems. Provide pipe guides and slide plates (MSS Type 35) in accordance with the following:

1. Anvil International, Inc. - Figure No. 439

2. PHD Manufacturing, Inc. - Figure No. 690

3. Carpenter & Paterson, Inc. - Figure No. 1010

4. Or equal

2.18 EXTENDED VERTICAL PIPING CLAMPS

A. Except as otherwise indicated, provide factory-fabricated extended vertical piping clamps. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping. Provide larger diameter clamps to accommodate insulated piping and shields. Provide vertical piping two-bolt extended riser clamps in accordance with the following

1. Anvil International, Inc. - Figure No. 100

2. Carpenter & Paterson, Inc. - Figure No. 267

3. PHD Manufacturing, Inc. - Figure No. 545

4. Or equal

2.19 OFFSET PIPE CLAMPS

A. Except as otherwise indicated, provide factory fabricated offset vertical piping clamps. Provide vertical piping 2-bolt offset riser clamps in accordance with the following

1. Anvil International, Inc. - Figure No. 103

2. Carpenter & Paterson, Inc. - Figure No. 179

3. PHD Manufacturing, Inc. - Figure No. 535

4. Or equal

2.20 PIPE RISER CLAMPS

A. Pipe riser clamps (MSS Type 8) shall be used to support vertical piping runs extending through floor slabs. Insulation shall be provided for the entire diameter of insulated pipes prior to installing riser clamps. Insulation shall not be damaged by clamp installation. Provide pipe riser clamps in accordance with the following:

1. Anvil International, Inc. - Figure No. 261

2. Carpenter & Paterson, Inc. - Figure No. 126

3. PHD Manufacturing, Inc. - Figure No. 550, 551, or 553

4. Or equal

2.21 WALL PIPE SUPPORTS

A. Where pipe runs are near supports, including, but not limited to walls, beams, and columns, and are also located an excessive distance from ceilings or the underside of beams, welded stainless steel wall pipe supports shall be used for hanging pipe. In cases where single pipes rest on top of bracket pipe supports, all attachments shall meet requirements as specified under multiple pipe hangers. Provide structural wall pipe supports in accordance with the following.

B. Light duty applications (MSS Type 31) shall be defined as small diameter piping less than 2 inches nominal pipe size.

1. PHD Manufacturing, Inc. - Figure No. 850

2. Carpenter & Paterson, Inc. - Figure No. 69

3. Or equal

C. Medium duty applications (MSS Type 32) shall be defined as 3 inch through 6 inch PVC or Stainless Steel piping.

1. PHD Manufacturing, Inc. - Figure No. 855

2. Carpenter & Paterson, Inc. - Figure No. 84

3. Or equal

D. Heavy duty applications (MSS Type 33) shall be used for all Type DI/1 & Type CS/1 piping and all piping materials larger than 6 inch nominal pipe size.

1. PHD Manufacturing, Inc. - Figure No. 860

2. Carpenter & Paterson, Inc. - Figure No. 139

3. Or equal

E. Where applicable and approved by the Engineer, the use of C-channels with stainless steel brackets and pipe clamps shall be provided. All members shall be securely fastened to walls, columns, or other Engineer approved structural members. Attachment shall utilize double expansion shields or other methods as approved by the Engineer. Additional wall bearing plates shall be provided where required.

2.22 MULTIPLE PIPE HANGERS

A. Suspended multiple pipes, running parallel in the same horizontal plane, which are adjacent to each other shall be suspended by trapeze type hangers or wall brackets. Trapeze hangers shall consist of stainless steel or aluminum structural channels supported from stainless steel threaded rods.

B. Provide all other necessary accessories, including, but not limited to rods, concrete inserts, C-clamps, beam clamps, welded beam attachments, and expansion shields, as required and as specified for a complete piping support system.

C. Unless otherwise specified or indicated on the Drawings, pipe anchors used for attaching pipe to trapeze or multiple pipe wall brackets shall be anchor or pipe chairs.

D. All chair U-bolts shall be tightened to allow freedom of movement for normal expansion and contraction of piping runs except where pipe shall be anchored to control direction of movement or act as a thrust anchor.

2.23 HANGER ROD ATTACHMENTS & BEAM CLAMPS

A. Hanger rod attachments shall be machine threaded. The strength of the rod shall be based on its root diameter. Threaded rods shall not be formed or bent in the field.

B. Hanger rods shall be attached to concrete structures using concrete inserts. Beam clamps, C-clamps, or welded beam attachments shall be used for attaching hanger rods to structural steel members.

C. Where required and as approved by the Engineer, expansion or epoxy anchors shall be used for attaching to concrete structures.

D. Provide a bituminous coating for all iron or steel in direct contact with concrete.

E. Both locknuts and retaining devices shall be furnished by the piping support manufacturer.

F. Field fabricated clamp bodies and retaining devices are not acceptable. Side beam or channel clamps (MSS Type 20) shall be provided with an added iron heel plate or adaptor. Whenever possible utilize center beam clamps (MSS Type 21).

2.24 ANCHORS

A. Anchor piping at locations indicated on the Drawings or required per the Specifications. The anchor design and materials shall be in accordance with ANSI/ASME B.31 standards. Additional anchoring shall be provided as approved by the Engineer. All anchors shall be 316 stainless steel regardless of installation location.

B. The length of expansion bolts shall be sufficient to place the wedge portion of the bolt a minimum of 1 inch behind the steel reinforcement. Concrete anchors for ceiling mounted pipe supports and appurtenances shall be adhesive or expansion type.

C. Anchors for wall supports, floor supports and all related appurtenances shall be in accordance with the following. Size all supports as required for proper support as well as to provide compatibility with the associated pipe support.

D. Anchor bolts shall be a product of the following Manufacturer:

1. Hilti – Kwik-Bolt

2. Simpson Strong-Tie – Wedge-All

3. Powers – Power-Stud

4. Or equal

2.25 INSULATION SHIELDS & SADDLES

A. Provide pipe covering protective saddles (MSS Type 39) on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher.

B. Provide pipe protection shields (MSS Type 40) for use on insulated piping systems less than 4 inches. Shields may be used on piping systems larger than 4 inches when the temperature of the medium is 60 degrees F or less. All shields shall be constructed of materials as previously indicated in this Section.

C. All protective shields shall be in accordance with the following:

1. Anvil International, Inc. - Figure No. 167

2. Carpenter & Paterson, Inc. - Figure No. 265

3. PHD Manufacturing, Inc. - Figure No. 170

4. Or equal

2.26 HORIZONTAL SMALL DIAMETER PIPE SUPPORTS

A. Horizontal piping runs less than 3 inches in diameter shall be held in position by supports fabricated from 304 stainless steel or aluminum C-channels, welded post bases and pipe clamps.

B. To assure adequate support, fabricate supports using two vertical members and post bases connected by a horizontal member of sufficient load capacity to support the piping run. Wherever possible, supports shall be anchored to nearby walls or other structural members to provide horizontal rigidity. More than 1 pipe may be supported from a common fabricated support as approved by the Engineer.

2.27 SMALL DIAMETER PLASTIC PIPE SUPPORT

A. Provide all pipe supports for closely spaced vertical plastic piping systems 3 inches and smaller to provide a rigid support system. The interval of vertical support spacing shall be as required by the pipe manufacturer, but in no case, shall the vertical spacing interval exceed 6 feet between supports. The support system shall consist of a framework suitably anchored to floors, ceilings, roofs or other Engineer approved structural members.

B. Vertical and horizontal supporting members shall be 304 stainless steel or aluminum U-shaped channels. The assemblies shall be furnished complete with all nuts, bolts and fittings for a complete assembly including end caps for all support members.

C. Vertical piping shall be secured to the horizontal members by pipe clamps or pipe straps.

D. The design of each individual framing system for small diameter plastic pipe support systems shall be the responsibility of the Contractor. Shop Drawings, shall be submitted and shall show all details of the installation, including dimensions and types of supports. In all instances the completed frame shall be adequately braced to provide a complete rigid structure when all the piping has been attached.

E. Size all supports for proper support as well as to provide compatibility with the associated piping material. Use only 1 type by 1 manufacturer for each piping service.

2.28 CUSTOM FABRICATED PIPE SUPPORTS

A. Whenever possible utilize standard piping supports and appurtenances. If standard supports are not suitable for an application, provide custom fabricated structural shapes, concrete, and anchor hardware for support of process piping systems.

B. All custom fabricated supports and hardware shall be of approved materials of construction like items previously specified, and shall meet all applicable requirements of this specification section.

C. Submit complete design details of the pipe support system and system components. Do not install custom fabricated pipe supports without the written approval of the Engineer.

2.29 THIN-WALLED PIPE SUPPORTS

A. Provide supports for thin walled pipe as specified, and include saddle bracing to avoid damaging the pipe at the point of contact with the associated support.

2.30 CONCRETE INSERTS

A. Provide inserts (MSS Type 18) to allow a connection point for hanger rods in concrete. Inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for (MSS Type 18) inserts. Provide a bituminous coating for all metallic inserts in direct contact with concrete. All concrete inserts shall be in accordance with the following:

1. Anvil International, Inc. - Figure No. 282

2. Carpenter & Paterson, Inc. - Figure No. 650

3. PHD Manufacturing, Inc. - Figure No. 951

4. Or equal

2.31 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 GENERAL

A. Hangers, supports, and guides shown on the Drawings are for coordination purposes and represent recommendations based on assumed pipe routing. Provide routing and installation of all hangers, supports and guides for complete piping systems.

B. Proceed with the installation of piping and supports only after any building structural work has been completed and all new concrete has reached its specified design strength in accordance with the requirements of Division 03.

C. The installation of pipe support systems shall in no way interfere with the operation of monorails, access hatches, building systems, overhead doors, etc. The installed systems shall not interfere with maintenance and operational access to equipment.

D. All pipe supports shall be designed with liberal strength and stiffness to support the respective pipes under the maximum combination of peak loading conditions including pipe weight, liquid weight, liquid movement and pressure forces, thermal expansion and contraction, vibrations and all probable externally applied forces, including seismic forces. Prior to installation, all pipe support systems shall be approved by the Engineer.

E. Design and adjust pipe support systems to allow for drainage of pipe.

3.02 SUPPORT LOCATIONS

A. Support piping such that piping live and dead loading, and stresses from movement, will not be transmitted to connected equipment, valves, tanks, couplings, and any other appurtenances that are not designed to support piping loads. Equipment shall not be used to support piping.

B. Support piping immediately adjacent to each change of direction and where installation of inline equipment produces concentrated loads. Provide support at offsets in piping as necessary to prevent deflection of the pipe axis due to expansion or pressure forces, except where right angle bends are utilized to compensate for expansion.

C. Provide independent support on either side of each valve and in-line instrument. Support shall permit removal and replacement of valve or instrument without affecting support of adjacent piping. Support of valves by connected piping is not acceptable. All electric and hydraulic valve actuators shall be independently supported.

D. Couplings: Support all couplings shown on the Drawings and as specified for connection to tanks, pumps, equipment, and appurtenances. All such couplings shall be rigidly supported, to prevent transfer of force to the equipment. Fixed or restraining supports shall not be installed between a flexible coupling and the connected piece of equipment/appurtenance. The supports shall be located at the end opposite the tank, pump, equipment, and appurtenance.

3.03 SUPPORT SPACING, GENERAL

A. Distance between pipe supports shall be the minimum of pipe manufacturer requirements, location requirements defined above, and spacing defined below.

B. Space supports so that the sag of the pipe (if any) is within the limits of the piping manufacturer. The support design and layout shall minimize bending stresses on the supported piping from concentrated loads between supports. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for the smallest pipe size or install intermediate supports for smaller diameter pipe.

3.04 SUPPORT SPACING, METALLIC PIPING

A. Minimum spacing for rigid metallic piping (including cast iron, ductile iron, steel and stainless steel) shall be per the following table:

Pipe Size (Inches)	Maximum Span (feet)
1½ inches & smaller	5 feet
2 inches to 4 inches	10 feet
5 inches to 8 inches	15 feet
10 inches & larger	20 feet

3.05 SUPPORT SPACING, PLASIC PIPING

A. Provide continuous support for plastic piping (including PVC and HDPE) whenever possible. Continuous support shall consist of v-troughs or ladder type cable trays.

B. Refer to the Drawings for typical v-trough support details and requirements.

C. All ladder type cable trays shall be constructed of PVC coated aluminum, aluminum or stainless steel. The ladder rung spacing shall be a maximum of l2 inches. The tray width shall be a minimum of 6 inches for single piping runs and l2 inches for double piping runs.

D. Secure plastic pipes to v-trough or ladder trays by clamps or fasteners. The spacing between clamps and fasteners shall not be greater than 10 feet.

E. Minimum spacing for rigid plastic piping (including PVC and HDPE) shall be per the following table:

Pipe Size (Inches)	Maximum Span (feet)
1½ inches & smaller	4.5 feet
2 inches to 4 inches	6 feet
5 inches to 8 inches	9 feet
10 inches & larger	10 feet

3.06 INSTALLATION

A. Install hangers, supports, clamps, and attachments to support piping properly from building structures in accordance with MSS SP-69.

B. Attach pipe supports to concrete walls, columns, structural steel, and other Engineer approved support members. The pipe support system shall not impose loads on the supporting structures in excess of the loads for which the supporting structure was designed.

C. Do not support piping from existing precast concrete tees, metal stairs, ladders, concrete columns or concrete beams or walkways unless specifically directed or authorized in writing by the Engineer. Do not use wire or perforated metal to support piping. Do not support piping from other piping.

D. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

E. Torque all Top Beam C-Clamps (MSS Type 19), C-Clamps (MSS Type 23), and any other hardware with specific torque requirements in in accordance with MSS SP-69 standards and manufacturer requirements.

F. Except as otherwise permitted, make provisions for vertical adjustment of all hangers after installation.

G. Where temporary supports are used, provide sufficiently rigid support to prevent shifting or distortion of pipe.

H. Apply anti-seize compound to all nuts, bolts, and other associated fasteners. Supports installed without the approved anti-seize compound shall be dismantled and correctly installed, at no additional cost to the Owner or Engineer.

3.07 CONCRETE INSERTS

A. Install concrete inserts on forms before concrete is placed. Before setting these items, all Drawings and figures shall be checked which have a direct bearing on the pipe location. Responsibility for the proper location of pipe supports shall be the responsibility of the installing Contractor. Continuous metal inserts shall be embedded flush with the concrete surface. Provide a bituminous coating for all metallic concrete inserts in contact with concrete.

3.08 FINISHING

A. All sharp edges and comers within 7 feet of the floor or walking surfaces shall be ground down and/or protected with plastic protective covers.

B. All ferrous metal surfaces shall be finished in accordance with Section 09 90 00. Stainless steel, galvanized steel, plastic, brass, bronze, copper and fiber-reinforced plastic (FRP) components shall not be painted unless otherwise specified.

3.09 TESTING

A. All pipe support systems shall be tested for compliance with this Specification and referenced standards. After installation, each pipe support system shall be tested in conjunction with the respective piping pressure tests as specified in Section 40 05 13. If any part of the pipe support system proves to be defective or inadequate, it shall be repaired and/or augmented to the satisfaction of the Engineer, at no additional cost to the Owner or Engineer.

3.10 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.11 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 40 61 01

INSTRUMENTATION AND CONTROLS GENERAL REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide instrumentation and controls in accordance with this Section and applicable reference standards listed in Article 1.03.

2. Work by Owner

a. Integration with existing SCADA system

B. Related Requirements

1. Division 26 Electrical – Specifications for electrical wiring standards and practices

2. Section 40 67 00 – Control System Equipment Panels and Racks

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. American National Standards Institute (ANSI)

2. ASTM International (ASTM)

3. FM Global (FM)

4. International Society of Automation (ISA)

a. ISA-RP60.3 Recommended Practice

5. National Electrical Code (NEC)

6. National Electrical Manufacturers Association (NEMA)

7. National Fire Protection Association (NFPA)

a. NFPA 70

b. NFPA 79 Electrical Standard for Industrial Machinery

8. Occupational Safety and Health Administration (OSHA)

9. Underwriters Laboratories (UL)

a. Standard 508A - Standard for Industrial Control Panels

B. Definitions

1. PLC – Programmable Logic Controller

2. RIO – Remote Input/Output Rack

3. OIT – Operator Interface Terminal

4. HMI – Human Machine Interface

5. RTU – Remote Terminal Unit

6. I/O – Input/Output

7. SCADA – Supervisory Control and Data Acquisition

8. Modules – devices that plug into a chassis or connect to an adjacent module and are keyed to allow installation in only one direction

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

1. Coordinate equipment, instrument and material delivery with Project schedule. Notify Engineer if delivery schedule of equipment, instruments, or material affects Project schedule. Include documentation from equipment Supplier indicating revised delivery schedule and reason for change.

2. Coordinate delivery of equipment, instruments or materials for installation in system or control panel provided under Section 40 67 00.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data

1. Instrumentation: in accordance with Section 40 70 00.

C. Shop Drawings

1. SCADA control panels: in accordance with Section 40 67 00.

D. Closeout and maintenance material submittals: per Division 01 General Requirements.

1. Provide operation procedures, equipment descriptions, intended modes of operation, system unit testing procedures and safety measures during operation.

2. Provide record drawings and instructions for maintenance of system equipment. Incorporate maintenance procedures and schedules, coordinate and cross-reference to detailed operational procedures provided by manufacturers.

3. Include a list of local, authorized distributor's service departments stocking manufacturer's parts and equipment and providing local service.

4. Instrument list or ISA data sheets, including tag numbers

5. Copies of all Shop Drawings, reports, maintenance data, and schedules, description of operation, and spare parts information.

6. Control panel section of O&M manuals shall include

a. Record drawings of control panels updated to reflect the panels after checkout and startup.

b. Installation and operation manuals for all major control panel components, network switches, and communication equipment.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Acceptance at Site

1. Check equipment, instruments and materials for damage or defects within 7 days of delivery.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

1.09 MAINTENANCE

A. Furnish extra materials as specified below. Make interchangeable with and of same material and workmanship as corresponding original parts.

B. Control Panel Spares: one of each type of the following.

1. Surge arrestor
2. Fuses (minimum 10 percent spares of each type)
3. 24 VDC communication power supply
4. Intrinsic safety barrier

PART 2 – PRODUCTS

2.01 MATERIALS

A. Provide instruments, SCADA control panels, and materials in accordance with Division 01 General Requirements.

1. Verify availability of equipment, instruments and materials and submit an "or-equal" or substitute if production is discontinued.

2.02 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.02 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

1. Test instruments and SCADA control panels for proper termination and operation, in presence of Engineer.
2. Calibrate instruments in accordance with manufacturer's recommended procedure.
3. Coordinate with Mission Communications to configure and program the Owner's reinstalled Mission unit to match the existing functionality.

3.03 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 40 67 00

CONTROL SYSTEM EQUIPMENT PANELS AND RACKS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide wiring, labor, tools, materials, and equipment to furnish, install, and test control panels and enclosures in accordance with this Section and applicable reference standards listed in Section 40 61 01, and shop drawing level drawings.

B. Work by Owner: as specified in Section 40 61 01.

C. Related Requirements

1. Section 26 05 00 – Common Work Results for Electrical
2. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables
3. Section 26 27 26 – Wiring Devices
4. Section 40 61 01 – Instrumentation and Controls General Requirements

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards: as specified in Section 40 61 01.

B. Definitions: in accordance with Section 40 61 01.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: in accordance with Section 40 61 01.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements and Section 40 61 01.

B. Product Data: as listed below unless letter regarding Shop Drawing level control panel Drawings are submitted as specified.

1. Bill of materials (BOM) for each control panel, including panel tag name or number and component description, quantity, manufacturer name and model number for each component used in fabrication. BOM: keyed to easily correlate components shown in bill of materials with components shown on control panel equipment layout Drawings.

2. Manufacturer's literature for each component identified on BOM. Clearly designate part number with highlights or arrows.

3. Equipment layout drawings for each control panel

4. Panel communication diagrams for each control panel

5. Power wiring diagrams for each control panel

C. Shop Drawings

1. A letter with copy of fabrication drawings confirming control panel fabricator will fabricate control panels as specified on shop drawing level control panel drawings may be provided in lieu of Shop Drawings.

D. Closeout and maintenance material submittals: per Division 01 General Requirements and Section 40 61 01.

1. As-Built Drawings

a. After fabrication of control panels and factory acceptance testing is complete, panel shop shall provide drawings of control panels, representing as-built conditions. Submit panel drawings in AutoCAD DWG and Adobe PDF file formats, on DVD-R media.

b. Submit with panels at delivery.

c. Legible red-line markups of shop drawing level drawings from panel shop may be provided if used in lieu of Shop Drawings.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Qualifications: per Division 01 General Requirements and as follows.

1. Control panel fabricator/panel shop fabrication facility: UL 508A certified, in operation at least 5 years, regularly engaged in furnishing, installing, and wiring similar equipment for use in water and wastewater treatment facilities, and minimum of 3 projects of similar scope in past 5 years.

2. Surge protection: provided by manufacturer with minimum of 5 years' experience in production of this equipment.

C. Panel Shop

1. Following control panel fabrication, apply power to each panel to ensure panels are wired correctly and devices contained within panels power up correctly. Provide written confirmation that a power up test was completed.

2. Complete point-to-point wiring checkout for wiring contained in control panels and correct any errors or omissions found. Provide written confirmation that checkout was completed.

3. Provide Engineer 5 days' notice of completion of control panel fabrication and have control panels available in their facility for Factory Acceptance Test by Engineer or System Integrator. Control panels may not be shipped prior to execution of Factory Acceptance Test unless indicated in writing by Engineer.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements and Section 40 61 01.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

1.09 MAINTENANCE

A. Extra materials and spare parts: as specified below. Make interchangeable with and of same material and workmanship as corresponding original parts.

B. Control panel spares: in accordance with Section 40 61 01.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Procurement of materials and manufacture of control panels shall not begin until related submittals have been reviewed and approved by the Engineer.

2.02 CONTROL PANEL COMPONENTS

A. Control Panel Components and Recommended Manufacturers

Control Panel Components	Expected level of quality: equivalent to listed manufacturers	Comments
Enclosures	Hoffman Hammond Saginaw	Suitable for use in environments where located per (NEMA, NFPA, etc.)
Wireway	Panduit Hoffman	
DIN Rail	Allen Bradley Phoenix Contact	
Radio Equipment		Match existing Site standards as necessary.
Terminal Blocks	Allen Bradley Phoenix Contact Entrelec	Utilize 2-tier terminal blocks wherever possible to conserve panel space.
Terminal Block Fuse Holders	Allen Bradley Phoenix Contact Entrelec	Specify fuse holders with blown fuse indicators.
Circuit Breakers	Square D Allen Bradley	
120VAC Surge Suppressors	Phoenix Contact Square D	
Analog Surge Suppressors	Phoenix Contact Citel	
Media Converters	N-Tron B&B Electronics L-Com	Provide with DIN rail mount converters as required on the network architecture
Fuses	Bussman Ferraz Shawmut	All glass fuses in control panels shall be fast acting style. Motor circuit protection and/or inductive load fuses shall be time delay style.
Control Relays	Allen Bradley Square D Omron	Include all required bases, hardware, etc.
Power Supplies	Sola Phoenix Contact Allen Bradley	Provide with power supplies sized as required for equipment contained within the enclosures and to supply field equipment connected to the enclosure.

Control Panel Components	Expected level of quality: equivalent to listed manufacturers	Comments
Intrinsic Safety Barriers	Pepperl & Fuchs MTL Phoenix Contact	Discrete barriers shall be 2-channel barriers. Analog barriers shall be 2-wire barriers.
Panel Heaters	Hammond Hoffman	Provide with panel heaters for outside control panels where temperature is a concern for electronic components.
Pilot/Status Lights (Push to test)	Allen Bradley General Electric Square D	Color code as follows: Red-Fault, Green-Run
HOR, On/Off, L/R switches and push buttons	Allen Bradley General Electric Square D	Refer to Section 26 27 26. Furnish switches and push buttons with matching nameplate

2.03 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 CONTROL PANEL FABRICATION

A. General

1. **Pump Motor Control Panel (PCP):** Pump Motor Control Panel to be provided by pump manufacturer. Reference Section 43 25 10 for additional details and requirements regarding the control panel.

   Fabricate the Pump Motor Control Panel using a wall-mounted NEMA 4 painted steel enclosure for installation within the Electrical Equipment Enclosure ‘EC-1’. The pump control panel enclosure will house the phase-converting pump VFDs, float controller, internal panel heater, thermostat, power supplies and associated terminals, breakers, fuses, wire way and DIN rail. The panel main breaker and associated power supplies shall be sized to supply power to the VFDs (240 VAC) and instruments (both 120VAC and 24VDC).

   a. Enclosure to be equipped with an enclosure air conditioner and heater for a complete thermal management system. Cooling and heating equipment to be sized taking seasonal temperatures and internal heat load from equipment into account.

b. One bay of the enclosure shall house the high voltage power distribution and motor control equipment and the opposite bay the controller hardware and components.

c. The power bay shall contain single or three phase circuit breakers, Variable Frequency Drives, main disconnect circuit breaker, control power transformer. Reference electrical Drawings for Control Panel Electrical One Line Diagram.

2. Control panels shall include pump monitoring relays, power supply, cables, and all appurtenances. Enclosures shall include switches, lights, annunciators and all appurtenances. Furnish panels and materials from one Supplier.

3. Provide electronic equipment utilizing printed circuitry and epoxy or equal coating to prevent contamination by dust, moisture, and fungus. Solid-state components: rated to provide reliable performance over ambient atmosphere fluctuations between 0 – 140 degrees F and 0 – 95 percent relative humidity, non-condensing. Field mounted equipment and system components: designed for installation in dusty, humid, and slightly corrosive service conditions.

4. Equipment installed in a hazardous area shall meet Class, Group, and Division to comply with the NFPA 70.

5. Provide heavy duty equipment, cabinets, and devices designed for continuous industrial service.

6. Fabrication requirements of control panels, enclosures, consoles, and cabinets.

a. Size control panel enclosures to provide at least 20 percent spare space for future expansion.

b. Provide control panel assemblies in compliance with UL 508A Standards.

B. Wiring

1. Interconnecting wiring: stranded and have 600-volt insulation.

2. Power distribution wiring on line side of fuses in accordance with Section 26 05 19.

3. Power and low voltage direct current (DC) wiring systems: routed in separate wireways. Crossing of power distribution wiring and control wiring: at right angles. Different system wires routed parallel to each other: separated by at least 6 inches. Different wiring systems shall terminate on separate terminal blocks. Wiring troughs may not be filled to more than 60 percent visible fill.

4. All wiring shall terminate onto single-or-double tier terminal blocks, where each terminal is sequentially numbered with a unique identifier. Direct interlock wiring between equipment is not allowed. Control panel: fabricated with minimum 20 percent spare terminals. Terminal blocks: arranged in vertical rows and separated into groups; power, alternating current (AC) control, DC signal. Terminal blocks: compression screw type. Spring-clamp style terminals will not be accepted.

    a. Discrete inputs (DI) and discrete outputs (DO) shall have 2 terminals per point with adjacent terminal assignments. Active and spare points: wired to terminal blocks.

    b. Analog inputs (AI) and analog outputs (AO) shall have a minimum of 3 terminals per shielded pair. Provide 3 terminals for direct connection of powered, 4-wire loops. Provide 4 terminals for direct connection of loop powered, 2-wire loops. Provide 5 terminals for connection of analog loops incorporating a local indicator or recorder. One terminal is for shielded ground connections for cable pairs. Ground the shielded signal cable at the control panel. Wire active and spare points to terminal blocks.

    c. Wire and tube markers in accordance with Section 26 05 00.

    d. Only 1 side of a terminal block row shall be used for internal wiring. Field wiring side of terminal shall not be within 6 inches of side panel or adjacent terminal, or within 8-inches of bottom of panel.

    e. Locate terminals for field wiring to reduce amount of routing through wireway to carry wiring to termination point.

5. Provide wiring, internal to panel and field wiring, with service loop to allow for future adjustment of termination point. Service loop: no more than 4-5 inches, stored in associated wireway.

6. Identify live circuit wiring, independent of the panel's normal circuit breaker protection.

7. All wiring shall be clearly tagged and color-coded in accordance with NEC. All tag numbers and color-coding shall correspond to panel wiring diagrams prepared by Engineer. All power wiring, control wiring, grounding, and DC wiring shall utilize different color insulation for each wiring system used. Utilize the following color coding scheme.

    a. Incoming 120 VAC Hot – Black

    b. 120 VAC Hot Wiring (control circuit wires downstream of panel circuit breaker) – Red

    c. 120 VAC Neutral – White

    d. Ground – Green with yellow stripe

    e. DC Wiring – Blue

    f. DC Common – White with blue stripe

    g. Intrinsically Safe Wiring - Light Blue

    h. Foreign Voltage – Yellow

C. Control Panel Loss of Power

1. Each control panel shall have an input configured to alarm the operators upon loss of main control panel power. Display alarm on SCADA nodes to alert operators that attention is required.

D. Control Panel Overcurrent Protection

1. Overcurrent protection devices: properly sized to protect associated devices and loads.

2. Circuit breakers: sized to protect associated equipment and provide necessary power to operate.

3. Fuses

    a. Glass fuses not associated with motor circuit protection or inductive loads: specified as fast-acting style. Fuses associated with motor circuit protection or inductive loads: specified as time delay style.

E. Lightning/Surge Suppression

1. Provide to protect control panel and associated equipment from surges on incoming power circuits, or those induced by lightning strikes and propagated along signal or power lines connected to control panels. Surge protection: sized properly for intended purpose.

2. 120 VAC Surge Suppression

a. Provide incoming 120 VAC power source for control panel with surge suppression located in the control panel. Provide surge suppressors with auxiliary contact to indicate surge suppressor failure. If there are multiple circuits within the same control panel, provide each incoming 120 VAC power source with surge suppression.

3. Analog Signal Surge Suppression

a. Supply analog signals connected to equipment or instrumentation located outside the building where the control panel is installed with DIN rail mounted surge suppression in control panel. Provide surge protection at both ends of signal cable and mount surge protection as close to equipment, instrument, or termination point as possible. Provide minimum of 10 kA surge current suppression.

4. Telephone Line and Ethernet Surge Suppression

a. Provide copper-based telephone lines and Ethernet cabling connected to control panel that leaves the building that houses the control panel with surge suppression in the control panel. Provide surge protection at both ends of telephone or Ethernet cabling and mount surge protection as close to termination point as possible.

F. Selector Switches, Pushbuttons and Pilot Lights

1. Provide for the enclosures in accordance with Section 26 27 26.

G. Seal Fail and Motor Temperature Relays

1. Pumps, mixers and other equipment equipped with proprietary seal fail and motor temperature relays, require relays to be mounted in the pump control panel SCADA control panel. Seal fail and motor over temperature alarm contacts: connected to SCADA alarm system as discrete inputs.

H. Intrinsic Safety Barrier Panels

1. Mount intrinsic safety barriers required for interfacing with equipment and instruments located in a classified area, in panel separate from control panels.

2. Panels housing intrinsic safety barriers: laid out to facilitate separation of hazardous and non-hazardous wiring. Wireway containing hazardous area wiring: clearly indicated.

I. Equipment Mounting/Arrangement

1. Mount components in a manner that permits servicing, adjustment, testing and removal without disconnecting, moving or removing any other component. Mount components on inside of panels on removable plates, not directly to enclosure. Mounting: rigid and stable unless shock mounting is required by manufacturer to protect from vibration. Identify components with plastic or metal engraved tags attached with drive pins adjacent to each component, identifying the component in accordance with the Drawings and Specifications.

2. Install exterior panel mounted equipment with suitable gaskets, faceplates, and other measures required to maintain NEMA rating of panel.

3. Provide minimum of 1-1/2 inches between panel wireway and terminal blocks for easy access to wiring.

4. Maintain manufacturer recommended spacing around panel-mounted equipment.

5. ISA-RP60.3 Recommended Practice: used as a guide in layout and arrangement of panels and panel mounted components.

J. Nameplates

1. Furnish panels and panel devices with nameplates identifying panel and individual devices with the following.

a. Device tag number: as shown on Drawings.

b. Functional description

c. Functional control description

2. Furnish 3/32-inch thick, black and white, Lamacoid nameplates with engraved inscriptions, unless escutcheon plates are specified or noted on Drawings. Letters: black against a white background. Edges of nameplates: beveled and smooth. Affix to panels using #4-40 threaded stainless steel button head hex screws.

3.02 INSTALLATION AND MOUNTING

A. Location of control panel shown on Drawings is approximate. Obtain information relevant to process control placement Work in the field. Exact location: approved by Owner or Engineer during construction. In case of interference with other Work, proceed as directed by Engineer.

3.03 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.04 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

B. Power up SCADA Panel upon delivery to Owner.

C. Power up control panels upon installation. Test field wiring for proper termination. Analog signals: simulated for a full scale 4-20mA test.

D. Provide testing of SCADA system with Integrator after installation of control panels and instruments, and termination of field wiring to panels is complete. Start up and testing: witnessed by Owner and Engineer.

3.05 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 43 25 10

SUBMERSIBLE SOLIDS HANDLING PUMPS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide wet well submersible solids handling pumps in accordance with this Section, the Drawings, the pump schedule on the Drawings, and applicable reference standards listed in Article 1.03.

B. Related Requirements

1. Section 05 50 00 – Metal Fabrications

2. Section 26 29 23 – Variable-Frequency Motor Controllers

3. Section 40 00 00 – Basic Process Materials and Methods

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. American Institute of Electrical Engineers (AIEE)

2. ASTM International (ASTM)

a. ASTM A48 Standard Specification for Gray Iron Castings

b. ASTM A532 Standard Specification for Abrasion-Resistant Cast Irons

c. ASTM B16.1 Standard Specification for Nickel Seamless Pipe and Tube

3. Hydraulic Institute (HI)

a. HI 11.6 Rotodynamic Submersible Pumps for Hydraulic Performance, Hydrostatic Pressure, Mechanical, and Electrical Acceptance Tests

4. International Electrotechnical Commission (IEC)

5. Institute of Electrical and Electronic Engineers (IEEE)

6. National Electric Code (NEC)

7. National Electrical Manufacturers Association (NEMA)

   a. NEMA MG 1 Motors and Generators

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, sequencing, and scheduling: per Division 01 General Requirements.

B. Pumps, Control Panel, VFDs, and floats shall be sole sourced from a single vendor to ensure compatibility between system components.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data

1. Manufacturer's product data, including parts listing, indicating compliance with requirements

2. Certified dimension prints showing fabrication, assembly, and installation, including anchorage details

3. Characteristics and performance data for each pump including guaranteed performance curves based on actual test data of duplicate units demonstrating compliance with specified requirements. Variable speed units including capacity/head curves and best efficiency point (BEP) for minimum of 3 reduced speeds between minimum to maximum speed. Plot curves capacity versus head, net positive suction head (NPSH) required, pump efficiency, brake horsepower, and motor horsepower. Show BEP and all specified operating points. Tabulate data at all operating points.

4. Weight of each major component and total weight of equipment

5. List of manufacturer’s spare parts including gaskets, bearings, and seals

6. Motor data including performance characteristics

7. Wiring diagrams and control schematics

C. Design calculations stamped by an engineer in state where Project is located for the following.

1. Concrete anchors

2. Custom concrete pads and pedestals

D. Manufacturers recommended shipping, unloading, storage, installation and testing procedures

E. Source and field quality control submittals

F. Manufacturer reports

1. Factory test report including test pump curves for supplied units following fabrication and prior to shipment, demonstrating compliance with requirements.

G. Qualification statements

H. Closeout and maintenance material submittals: per Division 01 General Requirements.

1. Operation & Maintenance Data

a. Complete bill of materials

b. Startup, normal, shut down, and emergency operating instructions

c. Lubrication and maintenance instructions

d. Guides to troubleshooting

e. Numbered parts list and predicted life of parts subject to wear

f. Test data and performance curves

g. Installation instructions

h. Written warranty statement

i. Include required cuts, drawings, equipment lists and descriptions required to instruct operation and maintenance personnel unfamiliar with such equipment.

2. Field test report including written certification of proper installation, initial adjustments, and satisfactory operations, dated and signed by manufacturer's representative. Indicate final position and set points of controls in report.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Qualifications: per Division 01 General Requirements and as follows.

1. Equipment: from a single manufacturer that has been regularly engaged in design and manufacture of submersible solids handling pumps for minimum of five years and not less than five years of experience in the production of pump models equal or larger than equipment specified herein.

2. Equipment manufacturer to provide a list of at least five similar installations, including contact names and phone numbers. All equipment: supported by a service organization that is, in the opinion of Engineer, reasonably convenient to the Site to ensure parts and service can be acquired in a timely fashion.

C. Certifications

1. Pump manufacturer: ISO 9001 certified, with scope of registration including design, control, and service after sales activities.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 01 General Requirements.

B. Examine space where equipment will be installed for tight clearances. Notify Engineer of any conflicts prior to placing order for equipment.

1.09 MAINTENANCE

A. Furnish extra materials as specified below. Make interchangeable with and of same material and workmanship as corresponding original parts.

B. Provide 1 set of the following spare parts for each pump.

1. Mechanical seals

2. Gaskets, O-rings, and lip seals

3. Wearing rings

4. Cable entry grommet and elastomer assembly

5. Spares of any additional parts subject to wear, and as recommended by manufacturer.

C. Provide 1 set of special tools required for normal operation and maintenance of pumps.

D. Obtain required lubricants for initial operation, including startup and 6-months of operation. Provide grades and quantities of oil supplied as recommended by pump manufacturer.

1.10 WARRANTY

A. Special warranty for pump equipment: 5-year pro-rated warranty.

PART 2 – PRODUCTS

2.01 GENERAL

A. Comply with applicable reference standards listed in Article 1.03.

B. Provide pumps, motors, and bases as a single unit from ISO 9001 certified pump manufacturer. Engineer and manufacture pumps under a written quality assurance ISO 9001 certified program.

C. Design and build equipment for 24-hour continuous service at all points within specified range of operation, without overheating, without cavitation, and without excessive vibration.

D. Provide complete pumping units. Design and proportion parts to have liberal strength, stability, and stiffness and adapted for service to be performed.

E. Provide working parts of pumps and motors, such as bearings, wearing rings, shaft, and sleeves of standard dimensions built to limit gauges or formed to templates so that parts are interchangeable between like units and that Owner may obtain replacement and repair parts.

F. Do not exceed nameplate ratings of motors. Do not allow design service factor to be reduced when pump is operating at any point on its characteristic curve at maximum speed.

G. Noise level of motors: not to exceed 85 dBA measured 3 meters from unit under free field conditions while operating on utility power.

H. Pump operation: capable of normal, continuous operation when flooded in water to depth of 65 feet or greater.

2.02 MANUFACTURERS

A. Keen Pump Company, Inc.

B. Homa Pump Technology

C. Vaughan Company

D. Or equal

2.03 PUMP SIZING AND PERFORMANCE

A. Refer to Pump Schedule for sizing and performance details and requirements for each pump.

2.04 PUMP

A. Type: ASTM A48, Class 30, 35 or 40 single piece gray cast iron volute, non-concentric design with smooth passages sized to pass solids entering impeller.

1. Minimum inlet and discharge size: as specified.

2. Flanged discharge connection: ANSI B16.1 Class 125.

B. Equip volute and impeller with replaceable and adjustable insert or wear rings.

C. Provide 400 or 430 stainless steel grade single-piece motor/pump shaft. Shaft sleeves not acceptable. Maximum deflection at shaft seal within allowable operating range: 0.002-inch.

D. Provide two independent mechanical shaft seal sets not requiring maintenance or adjustment, with stationary and positively driven parts.

1. Contacting sliding surfaces: single-piece tungsten or silicon carbide.

2. Other parts: stainless steel. Design seal springs to avoid contact with pumped fluid.

E. Provide Buna-N O-rings for stationary parts.

F. Provide cable entry seal to ensure watertight, submersible seal up to depth specified, consisting of threaded gland, compressible grommets, and positive stop. Design glands to provide strain relief independent of sealing function.

G. Provide NEC severe service “S”, type SJTO single cable with neoprene jacket for power and instrument conductors. Length: sufficient to reach termination point as shown on Drawings.

H. Hardware: 316 stainless steel.

I. Provide leak detection sensors indicating need for seal inspection. Leak detection: capable of providing ample warning of seal failure prior to damage incurred by leak to bearings, stator, or other motor components.

2.05 IMPELLERS

A. Type: statically and dynamically balanced single-piece impeller, keyed and held in place with a single stainless-steel bolt.

B. Impeller materials: provided per Pump Schedule and as defined below.

1. Gray cast iron: ASTM A48 Class 30 gray cast iron.

2. White iron: ASTM A532 (Alloy III A) 25 percent chrome cast iron.

3. Duplex SS: ASTM A743 cast duplex stainless steel, CD4MCu.

C. Impeller types: provided per Pump Schedule and as defined below.

1. Chopper/grinder: low-profile, multi-vane, semi-open impeller with sharpened edges. Cutter ring or bar mounted on suction end of pump works in conjunction with sharpened impeller to shred fibrous materials including wet wipes and rags prior to entering volute. An optional cutting tool mounted to impeller shaft on exterior of pump inlet cutter ring or bar may be used to further break down large materials prior to entering pump inlet.

2.06 MOTORS

A. Motor unit

1. Type: NEMA B squirrel-cage induction motor, submersible-type according to IEC 60034, and protection class IP68. Design motor to operate while permanently submerged by water column up to 65 feet. Motors with protection class IP67 only capable of being submerged for a limited time not acceptable.

2. Horsepower rating: no less than maximum brake horsepower requirements of pumps over range of pump performance curve.

3. Service factor: 1.15 over 40 degrees C ambient.

4. Thermal overload protection with automatic reset

5. NEMA MG 1 Part 31 continuous or intermittent, inverter-duty

6. Provide windings suitable for operation on VFDs.

7. Provide NEMA report of test form for tests conducted according to AIEE Test Code as specified in NEMA MG 1.

B. Motor housing

1. Type: air filled, watertight design. Oil-filled motors only acceptable on dry-pit installations for motor sizes less than 15 hp.

2. Class H insulation

3. Cooling system

a. For motors less than 15 hp: Provide cooling system to cool pumps by surrounding process water or air and not require supplemental cooling over range of specified operating conditions.

C. Radial and thrust bearings: factory pre-lubricated for life and suitable for all conditions within allowable operating range. Provide protection for bearings from stray electrical current damage caused by operation on VFDs for lifespan of bearing.

1. Provide bearings with minimum L10 lifespan of 50,000 hours over allowable operating range for motors less than 30 hp.

2.07 GUIDE RAIL BASE ASSEMBLY FOR WET-PIT INSTALLATIONS

A. Install pump on discharge elbow and guide rail system mounted permanently to structure and connected to pump discharge piping. Design base elbow to support weight of pump with no portion of pump allowed to rest on wet well floor. Anchor and grout base elbow to wet well per manufacturer recommendations. Design pump to engage and disengage discharge elbow from above without entry into structure. When lowered, pump to make tight seal with base elbow.

B. Employ either a single or dual guide rail system extending from base elbow to top of station for guiding pump out of wet well. Guide rails: 316 stainless steel schedule 40 with minimum diameter of two inches. Provide number and frequency of intermediate brackets in accordance with manufacturer’s recommendations.

C. Provide pumps with cast iron slide bracket that mates to discharge elbow. Utilize field replaceable Nitrile (Buna-N) rubber profile gasket or O-ring or metal-to-metal contact between pump discharge flange and base elbow to accomplish positive sealing of slide bracket to base elbow.

D. Provide pump lifting assembly consisting of 316 stainless steel shackle, chain, wire rope, and steel grab link device. Design pump lifting assembly to allow for removal of pump in single lift. Pump lifting assembly: rated for twice the weight of pump.

2.08 CONCRETE ANCHORS

A. Anchor pumps stands, bases, pedestals, and appurtenances to concrete using manufacturer-provided mounting holes. Concrete anchors to allow for level adjustment of pump prior to grouting.

B. Concrete anchors: provided in accordance with Section 05 50 00.

2.09 CONTROLS

A. The pump manufacturer shall provide a completely self-contained duplex motor control panel 'PCP-1' in accordance with Section 40 67 00 Control System Equipment Panels and Racks. The control panel shall include all switches, relays, indicator lights, digital displays, and controllers as required. The control panel shall interface with the Owner's SCADA control system as shown on the Drawings for remote status and monitoring. Refer to Division 40, the Drawings, and associated specifications for additional details and requirements regarding controls.

B. The control panel shall provide phase-converting VFDs for the pump motors. Refer to Section 26 29 23 specifications for additional details and requirements regarding VFDs. The pumps shall be run at 100% speed and will not require speed control.

C. The control panel shall provide short circuit and overload protection for each pump. Also provide lightning and surge protection on the input to the control panel for both a lightning arrestor and surge capacitor. An automatic alternator with manual override switch shall be provided to manually select the lead pump duty between the two pumps on successive cycles. The pump control panel shall have the following features at a minimum:

1. A moisture sensing circuit shall be provided to detect water leakage into the cavity of the pump. The circuit shall latch through a contact, de-energize the motor, provide auxiliary output contact for remote indication and energize a pilot light indicating a seal failure. A pushbutton shall be provided to reset the circuit after the seal failure has been corrected.

2. A motor over-temperature sensor shall be provided to detect abnormal and detrimental motor temperature, de-energize the motor, provide auxiliary output contact for remote indication and energize a pilot light indicating temperature alarm. A pushbutton shall be provided to reset the circuit after the over-temperature condition has been corrected.

3. The control panel and assembly shall conform to National Electrical Manufacturer's Association (NEMA), Joint Industry Council (JIC), and National Electrical Code (NEC) specifications, and shall be Underwriters' Laboratories (UL) listed. The panel shall be factory wired and tested.

4. Four mechanical float level switches will sense wet well water levels for starting and stopping of each pump: “low level”, “pump off,” “pump on”, “high level”. The general mode of operation shall be the lead pump starting when the “pump on” level is reached in the wet well and ceasing the pump when the “pump off” level is reached in the wet well. The “lead” and “lag” pumps will automatically alternate after each cycle. The pumps shall operate together in parallel if the liquid level in the wet well reaches the “high” level with the lead pump operating. The “low level” mechanical float when engaged shall cease the pumps from operation until the float becomes disengaged. When either pump is set to off mode, the pump shall not operate. When either pump is set to manual mode, the pump shall operate and bypass all automatic features. When either pump is in automatic mode, the pumps shall be started/stopped using the float switches in the wet well.

5. The pump control panel shall have the following dry contacts available to be wired to the Owner’s Mission system. Pump 1 Fault and Pump 2 Fault shall be common alarms for overtemp and seal fail.

    a. Pump 1 Run

    b. Pump 2 Run

    c. Pump 1 Fault

    d. Pump 2 Fault

    e. High Wetwell Level

    f. Low Wetwell Level

    g. Generator Fail

    h. Intrusion

D. Float Level Switches

1. The pump manufacturer to provide 4 float type non-mercury switches, encapsulated within a solid polyurethane float ball. The float type level sensors to operate the pumps and detect low and high water levels in the wet well as specified. Provide level sensors with individual float weights. Provide a mounting bracket near the access opening to allow adjustment of the control and alarm levels as shown on Drawings.

2. Furnish each non-mercury float switch with cable lengths to suit the installation without splices. Refer to Drawings for requirements. A properly rated electrical cable with a screwed, sealing type, cord-grip shall connect the switches to the electrical junction box. Float switches to be weighted and provided with intrinsically safe relays in the control panel.

3. Float Mounting Bracket shall be SJE-Rhombus model #1009432 or equal.

E. Alternator

1. An electromechanical alternator shall be provided to alternate the lead pump duty between the two pumps on successive cycles. The alternator shall be a single device; alternator circuits comprised of two or more relays shall not be considered equal. A selector switch shall be provided to bypass the alternator and select either pump as the lead pump. The selector switch shall be as specified.

F. Selector Switches

1. A hand-off-auto selector switch shall be provided for each pump on the front of the control panel. Selector switches shall be of oil-tight construction. Toggle switch types shall not be considered equal. Selector switch contacts shall be heavy duty, double-break, silver.

G. Relays

1. General purpose relays shall be NEMA 300-volt open frame industrial control type. Intrinsically safe relays shall be furnished for interconnection of each non-mercury float switch with the control panel. Refer to Section 40 67 00 for additional details and requirements regarding intrinsically safe relays.

H. Terminal Blocks

1. All electrical components interconnected to the control panel shall terminate on terminal blocks. Terminal blocks shall be sized for 14-gauge wire with terminal block numbers and a legend. Wires shall be neatly run through wire raceways and numbered with adhesive type labels. The power connection to each system shall be through a non-fused disconnect switch with terminals.

I. Control Circuit

1. The control circuit of the control panel shall operate at 120 VAC and shall be fuse protected. Tripping the circuit breaker of either pump shall not disable the control circuit.

J. Elapsed Time Meters

1. Provide a non-reset meter for each pump to indicate elapsed time of operation of the pump from 0 to 99,999.9 hours and locate on the front of the control panel.

K. Indicating Lights

1. A green "pump running" light shall be provided for each pump. All indicating lights shall be transformer type, oil-tight, press-to-test with colored lens and legend plate. Locate lights on the front of the control panel.

2. A list indicating the minimum lights is listed below:

a. Pump 1 Run

b. Pump 2 Run

c. Pump 1 Over Temp

d. Pump 2 Over Temp

e. Seal Fail 1

f. Seal Fail 2

g. High Level

h. Low Level

i. Generator Fail

2.10 LUBRICATION

A. Provide lubrication fittings readily accessible from outside without removing covers, plates, housings, or guards.

2.11 SURFACE PREPARATION AND PAINTING

A. Ferrous metallic surfaces including pump, motors and slide brackets: thoroughly cleaned, dry and free from all mill-scale, rust, grease, dirt, and other foreign matter before exposure to weather and prior to shop painting.

1. Items not manufactured from corrosion-resistant materials or otherwise protected: blast cleaned prior to painting.

2. Properly protect nameplates during painting.

B. Ferrous metallic surfaces: field applied with manufacturer’s standard two-part epoxy coating.

1. Coating: resistant to sewage, high humidity, hydrogen sulfide and other chemicals normally found in wastewater.

2. Do not paint galvanized, stainless steel, brass, bronze, aluminum, plastic and FRP components.

C. Provide touch-up paint as specified to restore integrity of coating system that may be damaged during construction.

2.12 NAMEPLATES

A. Provide nameplates in accordance with Section 40 00 00.

1. List manufacturer's name, address, equipment type or style, model or serial number, catalog number, rated capacity, speed, and other pertinent data.

2. Show at least minimum information required by NEMA MG 1 standards on nameplates for electric motors.

2.13 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements. Comply with applicable reference standards listed in Article 1.03.

B. Test pump performance in accordance with HI 11.6 standards at manufacturer’s facility prior to shipment.

C. Test pump performance at minimum of five points spanning full range of allowable operating conditions including all points within allowable range specified in Pump Schedule. Record capacity, head, motor speed, pump speed, efficiency, input horsepower, and vibration for each test point. Develop pump test curves to illustrate conformance with specified performance. For variable speed units, test each pump at full speed plus 3 equally spaced speeds between maximum and minimum design conditions.

D. Hydrostatically test each pump to 1.5 times shutoff head.

E. Pump performance

1. Meet or exceed HI acceptance tolerance grade specified in Pump Schedule for specified duty point. HI acceptance grades in table below for reference.

2. If no acceptance tolerance grade specified, evaluate pumps in accordance with HI default acceptance grade criteria.

Test Parameter	Guarantee Requirement	Grade	Grade 1			Grade 2		Grade 3
		Δt_Q	10%			16%		18%
		Δt_H	6%			10%		14%
			Acceptance Grade					
		Symbol	1B	1E	1U	2B	2U	3B
Rate of flow	Mandatory	t_Q (%)	± 5%	± 5%	0% to + 10%	± 8%	0% to + 16%	± 9%
Total head	Mandatory	t_H (%)	± 3%	± 3%	0% to + 6%	± 5%	0% to + 10%	± 7%
Power [a]	Optional (either/or)	t_P (%)	+ 4%	+ 4%	+ 10%	+ 8%	+ 10%	+ 9%
Efficiency [a]		t_η (%)	− 3%	− 0%	− 0%	− 5%	− 5%	− 7%

[a] The power and efficiency tolerances are not the result of an exact calculation using maximum values of a related column. They are instead reflecting real life experience. For grade 1E and 1U, no negative tolerance on efficiency is allowed.

NOTE: All tolerances are percentages of values guaranteed.

F. Test motors in accordance with IEEE standards and at no load running current, high potential, and winding resistance.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install pumps and motors in accordance with manufacturer's written instructions and under direct supervision of manufacturer's representative. Install and assemble pumps and other equipment in accordance with Drawings and with manufacturer's installation instruction manual. Provide bolts, shims, tools, and other devices necessary for installing pumping units.

B. Accurately align pipe flanges connected to pump prior to tightening connecting hardware to ensure no strain is induced from adjoining piping. Independently support surrounding pipes, valves, fittings, and appurtenances without imposing any strain on pump casing.

C. Provide required lubricants for initial operation. Grade of lubricants: in accordance with the manufacturer's recommendations.

D. Obtain certificate from pump manufacturer stating installation of pumping equipment is satisfactory, equipment is ready for operation, and operating personnel have been suitably instructed in operation, lubrication and care of each unit provided.

3.02 FIELD PAINTING

A. Provide field painting in accordance with Section 09 90 00.

B. Do not paint stainless steel, galvanized steel, and nonferrous surfaces.

C. Clean factory painted items requiring touching up in field of all foreign material. Prime and topcoat with manufacturer's standard factory finish.

3.03 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements. Comply with applicable reference standards listed in Article 1.03.

B. Site/Field Tests and Inspections

1. Confirm units and appurtenances have been installed correctly and that assembly is free from undue stress imposed by piping or mounting bolts. Demonstrate that hardware connecting suction and discharge piping to pump can be removed and reinstalled by hand to ensure absence of pipe strain.

2. After installation of pumping units and appurtenances is complete, test pumping equipment for proper operation. Ensure manufacturer's representative is present during each test. Notify Engineer 1 week prior to test and confirm with Engineer 24 hours prior to test.

3. Test pumping equipment in accordance with HI 11.6 standards using clean water or treated effluent.

   a. Process water may be used in lieu of clean water for field tests if supply of clean water for testing is not feasible or practical at discretion of Engineer. At minimum, clean water is recommended for initial pressure tests of system.

   b. If leaks are found using non-clean water, clean and disinfect area prior to correcting installation and retesting.

4. Conduct running field test on each pumping unit in presence of Engineer and manufacturer’s representative for minimum of 2 hours. Operate each pumping unit at its rated capacity and operating points specified.

   a. Throttle discharge valves or run multiple pumps simultaneously to achieve specified heads. Use an accurate method of measuring discharge flow and suction and discharge heads. Use of new, calibrated, and tested station flow meter and pressure gauges is acceptable.

b. Test to confirm units have no objectionable heating, vibration, or noise from any parts, and that manual and automatic controls function properly. If any deficiencies are revealed during any tests, correct such deficiencies and repeat testing.

5. Provide vibration testing by qualified and independent testing company. Test each complete system with vibration measurement system installed at top motor bearing location installed at 45-degree angle radial to shaft centerline. Conduct vibration testing in presence of manufacturer's representatives in accordance with tolerances and procedures outlined in HI 11.6.

a. In the event vibration exceeds specified limits and cause of vibration is attributable to pumping equipment, make necessary balancing or alignment adjustments to bring equipment to within specified limits.

b. In the event vibration exceeds specified limits and cause of vibration is attributable to field conditions, work with Engineer to remedy installation.

6. Provide field test booklets for each unit showing field tests performed to adjust each component and field tests performed to prove compliance with specified performance criteria, upon completion and testing of installed system. Indicate final position of controls and data gathered during testing in field test booklets and ensure test booklets are signed by manufacturer's representative, Contractor, and Engineer.

C. Manufacturer Field Services

1. Obtain and pay for travel and services of a factory trained service representative to assist in installation, field testing, startup, and checkout.

2. Provide field training course for designated operating and maintenance staff members. Provide training in conjunction with visit of manufacturer's service technician. Start field training after system is functionally complete but prior to final acceptance tests. Cover all items contained in operating and maintenance manuals, including normal operations, troubleshooting, maintenance, lubrication, and other related Work.

3. Provide signed and dated certification of proper installation and satisfactory operation to Owner and Engineer.

3.04 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.05 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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Appendix A: Reference Drawings

TOWN OF TEWKSBURY, MASSACHUSETTS

SEWERAGE WORKS IMPROVEMENTS
PHASE 9

CONTRACT NO. 31

BOARD OF SELECTMEN

CHARLES E. COLDWELL, CHAIRMAN
JOHN MACKEY, VICE CHAIRMAN
JOHN RYAN, CLERK
JEROME SELISSEN
JOESPH P. GILL, JR.

TOWN MANAGER

DAVID G. CRESSMAN

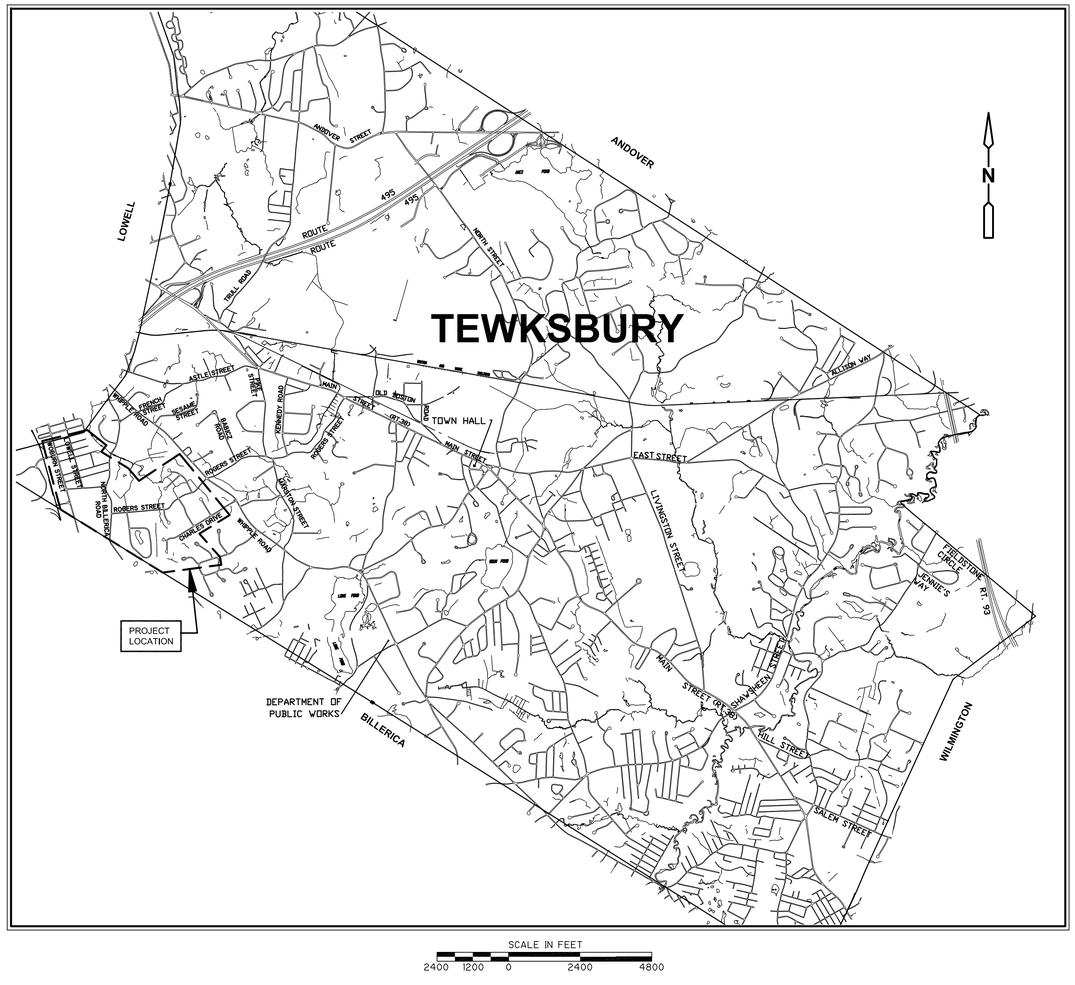
SUPERINTENDENT OF PUBLIC WORKS

TOMA DUHANI, P.E.

TOWN ENGINEER

LISA E. DEMEO, P.E.

JANUARY 2007



LOCATION PLAN

RECORD DRAWING

CDM Camp Dresser & McKee Inc.
CAMBRIDGE, MASSACHUSETTS

Consulting ***Engineering*** ***Construction*** ***Operations***

LIST OF DRAWINGS

SHEET	TITLE
GP	GENERAL PLAN
LGN	LEGEND AND GENERAL NOTES
1	NORTH BILLERICA ROAD, CROSS COUNTRY AND HIGHLAND AVENUE
2	HIGHLAND AVENUE AND LOWELL STREET
3	KERNWOOD AVENUE, WOBURN STREET AND LOWELL STREET
4	WOBURN STREET
5	LOWELL STREET, FOREST AVENUE AND FELKER STREET
6	FOREST AVENUE, GREENWOOD AVENUE AND WOBURN STREET
7	JAMES AVENUE AND KERNWOOD AVENUE
8	MELROSE AVENUE, LOWELL STREET AND PARK AVENUE
9	NORTH BILLERICA ROAD
10	NORTH BILLERICA ROAD
11	JAMES AVENUE, KERNWOOD AVENUE AND PARK AVENUE
12	NOT USED THIS CONTRACT
13	NINA DRIVE
14	PINTA DRIVE
15	NOT USED THIS CONTRACT
16	DEVONSHIRE ROAD
17	CHARLES DRIVE
18	CHARLES DRIVE AND TILTON CIRCLE
19	CHARLES DRIVE
20	CROSS COUNTRY AND WORTHEN PLACE
21	WORTHEN PLACE
22	FARWOOD ROAD AND WESCOTT CIRCLE
23	ROGERS STREET
24	CROSS COUNTRY AND HAWTHORNE CIRCLE
25	ROGERS STREET
26	WEDGEWOOD ROAD
27	HAROLD PLACE
28	ROGERS STREET
29	NORTH BILLERICA ROAD
30	HEIDENRICH DRIVE
31	HEIDENRICH DRIVE
32	HEIDENRICH DRIVE
33	HEIDENRICH DRIVE
34	DEVONSHIRE ROAD PUMPING STATION DETAILS
35	ELECTRICAL SYMBOLS, ABBREVIATIONS AND DETAILS
36	DEVONSHIRE ROAD PUMPING STATION - ELECTRICAL DETAILS AND ONE LINE DIAGRAM
37	MISCELLANEOUS DETAILS I
38	MISCELLANEOUS DETAILS II
39	MISCELLANEOUS DETAILS III
40	TRAFFIC MANAGEMENT PLAN I
41	TRAFFIC MANAGEMENT PLAN II

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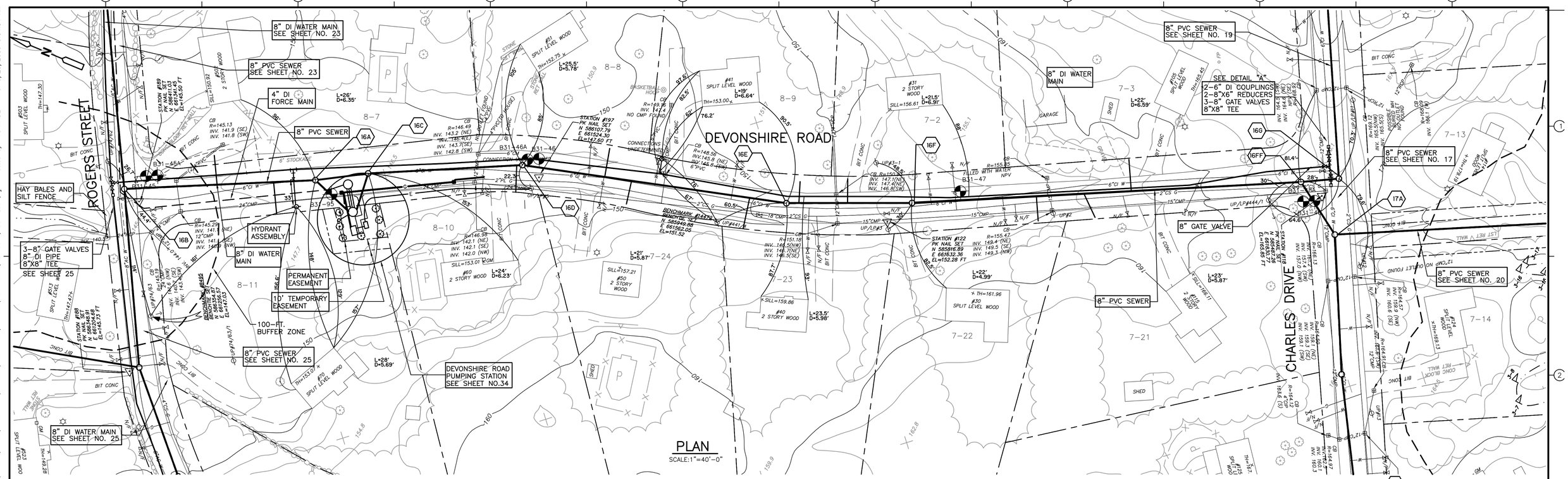
0959-70337

{ProjectWise} Filename: C:\cdmxm\richarde\dms41646\CSTPL023.DWG Xref's: [C24X36H, TK3HT, TK3IT, PROPERTY, LAYOUT, CSVPL001, LAYOUT, CSVPL001, LAYOUTA, CSVPL001,] Plotted by: RICHARDE Time: 3/23/2009 9:34:34 AM


ROGERS STREET
DEVONSHIRE ROAD
CHARLES DRIVE
8" DI WATER MAIN SEE SHEET NO. 23
8" PVC SEWER SEE SHEET NO. 23
4" DI FORCE MAIN
8" PVC SEWER
HAY BALES AND SILT FENCE
3-8" GATE VALVES 8"DI PIPE 8"X8" TEE SEE SHEET 25
HYDRANT ASSEMBLY
8" DI WATER MAIN
PERMANENT EASEMENT
10' TEMPORARY EASEMENT
100-FT. BUFFER ZONE
8" PVC SEWER SEE SHEET NO. 25
8" DI WATER MAIN SEE SHEET NO. 25
DEVONSHIRE ROAD PUMPING STATION SEE SHEET NO.34
8" PVC SEWER SEE SHEET NO. 19
8" DI WATER MAIN
SEE DETAIL "A" 2-6" DI COUPLINGS 2-8"X6" REDUCERS 3-8" GATE VALVES 8"X8" TEE
8" PVC SEWER SEE SHEET NO. 17
8" GATE VALVE
8" PVC SEWER
8" PVC SEWER SEE SHEET NO. 20
STATION #189 PK NAIL SET N 585434.91 E 661204.89 EL=146.73 FT
STATION #188 PK NAIL SET N 585256.57 E 661134.45 EL=145.50 FT
STATION #197 PK NAIL SET N 586107.79 E 661524.30 EL=147.60 FT
STATION #122 PK NAIL SET N 585916.89 E 661832.36 EL=152.28 FT
BENCHMARK #13479 BENCHMARK #13478
CONNECTION TO UNDETERMINED
PLAN
SCALE:1"=40'-0"
DETAIL "A"
N.T.S
TIES TO SERVICE CONNECTIONS ARE SHOWN ON TOWN OF TEWKSBURY "RECORD OF SEWER SERVICE" CARDS.
EXISTING GROUND SURFACE
LEDGE
4" DI FORCE MAIN SEE SHEET NO. 23
4" DI FORCE MAIN SLOPE CONTINUOUSLY UPWARD
8" PVC SEWER I=138.00 SEE SHEET NO. 23
8" PVC SEWER I=137.86 SEE SHEET NO. 25
12" PVC SEWER S=0.0022 L=168'
L=137' 8" PVC SEWER S=0.0075
L=236' 8" PVC SEWER S=0.0097
L=114' 8" PVC SEWER S=0.0045
L=400' 8" PVC SEWER S=0.0334
L=38' 8" PVC SEWER S=0.0321
L=32' 12" PVC SEWER S=0.0022
8" PVC SEWER I=159.72 SEE SHEET NO. 19
8" PVC SEWER L=40' S=0.0795
8" PVC SEWER I=156.37 SEE SHEET NO. 17
5'-0" MIN. COVER
RIM ELEV. 145.39
RIM ELEV. 146.34
RIM ELEV. 146.45
RIM ELEV. 147.41
RIM ELEV. 150.26
RIM ELEV. 152.87
RIM ELEV. 165.43
RIM ELEV. 166.40
WYE, HSE #70 MH 16A+87'
WYE HSE #502 ROGERS ST. MH 16A+37'
WYE, HSE #60 MH 16C+151.5'
WYE, HSE #51 MH 16D+73.5'
WYE, HSE #50 MH 16D+97.5'
WYE, HSE #40 MH 16D+203'
WYE, HSE #41 MH 16E+11'
WYE, HSE #31 MH 16E+54'
WYE, HSE #30 MH 16F+110'
WYE, HSE #115 CHARLES DRIVE MH 16F+152'
WYE, HSE #105 CHARLES DRIVE MH 16F+194'
I=137.76
I=137.40
I=137.40
I=137.33
I=137.37
I=138.46
I=136.64
I=142.07
I=142.21
I=142.73
I=142.73
I=156.26
I=156.48
I=159.66
EXIST. 6"CI
UP #11
UP #12
UP #444/1
8" DI
PROFILE
HOR.1"=40'-0"
VERT.1"=4'-0"

RECORD DRAWING

REV. NO.	DATE	DRWN	CHKD	REMARKS
1	03/09	EJR	SMK	REVISED FOR RECORD

DESIGNED BY: M. COTE
DRAWN BY: B. GUILFORD
SHEET CHK'D BY: M. GUIDICE
CROSS CHK'D BY: R. SOUPPA
APPROVED BY: R. SOUPPA
DATE: JANUARY 2007

CDM Camp Dresser & McKee Inc.
consulting engineering construction operations

TOWN OF TEWKSBURY, MASSACHUSETTS
SEWERAGE WORKS IMPROVEMENTS
PHASE 9
CONTRACT NO. 31

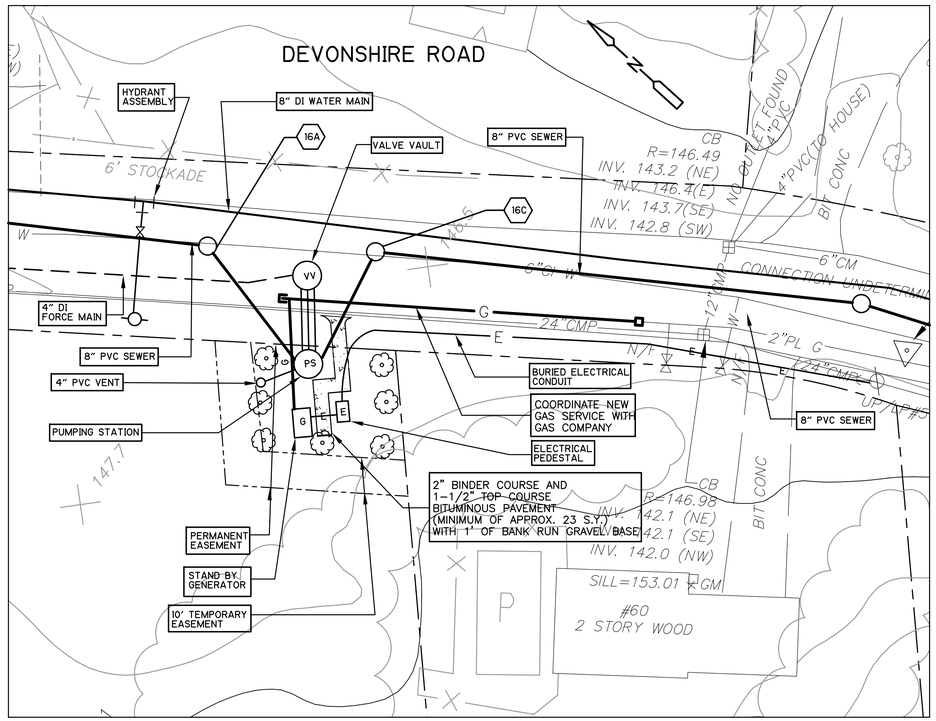
DEVONSHIRE ROAD

PROJECT NO. 0959-44636
FILE NAME: CSTPL023

SHEET NO.
16

ACCESSION NO. 0959-70354

{ProjectWise} Filename: C:\cdmxm\Vichar\e\cdmxm\dms41646\CPSPL001.DWG Xref's: [C24X36H, CSVPL001, PROPERTY, LAYOUT, TK3IT,] Plotted by: RICHARDE Time: 3/27/2009 3:34:52 PM



DEVONSHIRE ROAD PUMPING STATION

SCALE : 1"=20'-0"
(SEE SHEET NO. 16)

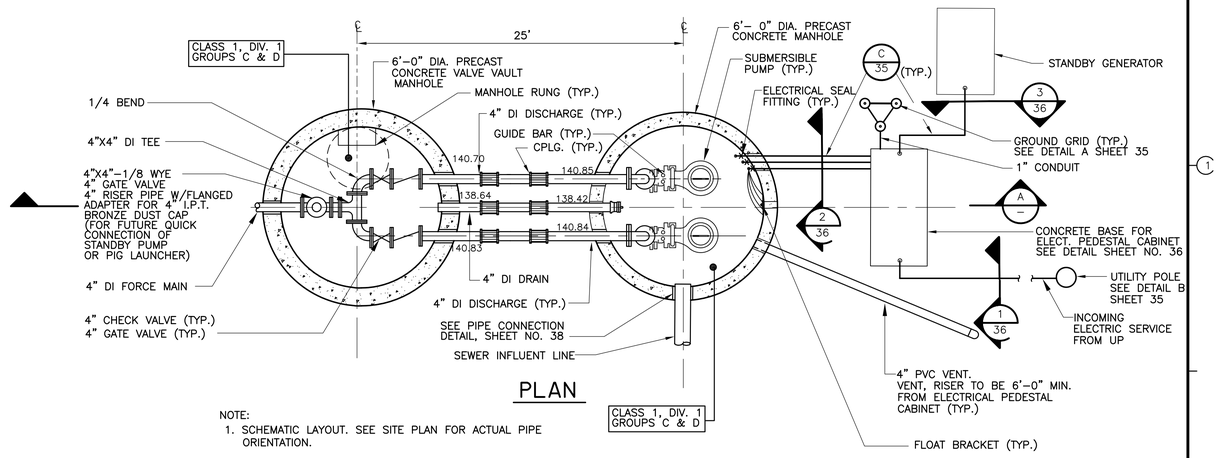
NOTE

REFER TO OPERATION AND MAINTENANCE MANUAL FOR ACTUAL INSTALLED MATERIALS AND EQUIPMENT

TIES TO SERVICE CONNECTIONS ARE SHOWN ON TOWN OF TEWKSBURY "RECORD OF SEWER SERVICE" CARDS.

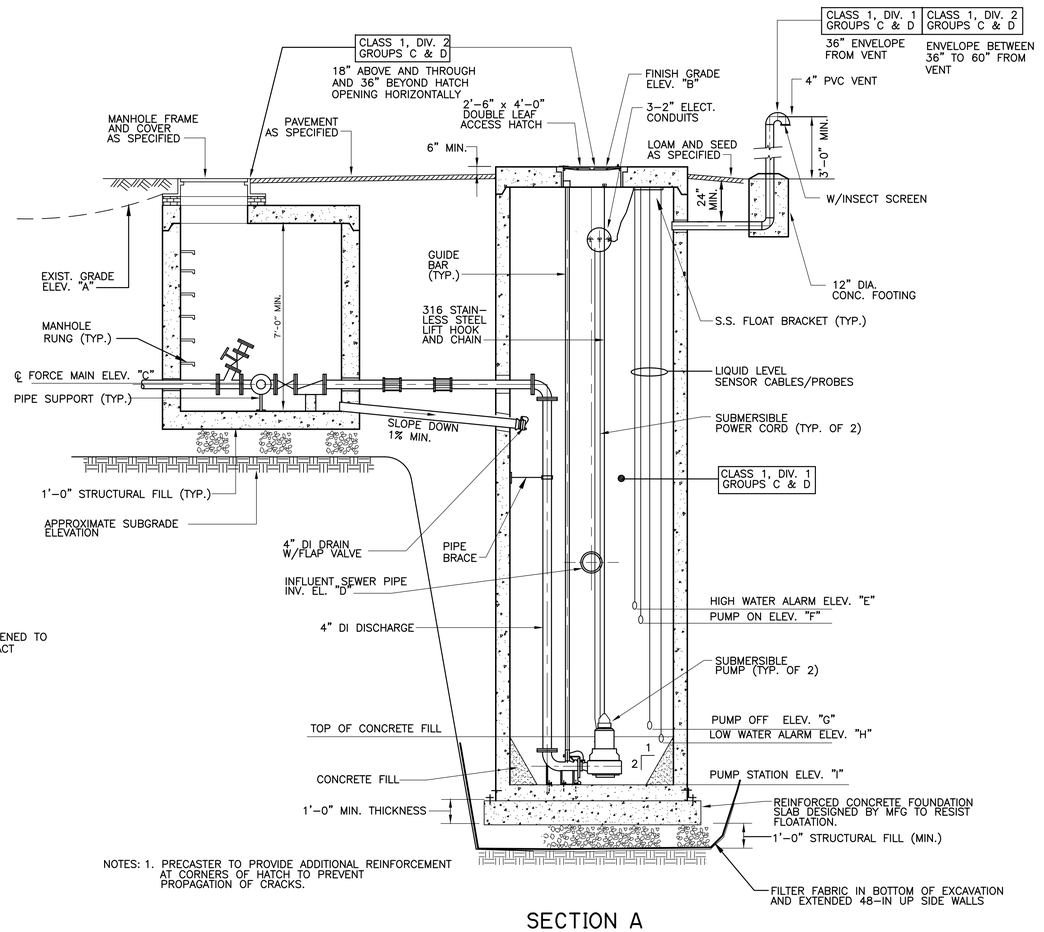
	DEVONSHIRE ROAD	
EXIST. GRADE ELEV. (A)	146.70*	
FINISHED GRADE ELEV."B"	147.20	
F.M. CENTERLINE ELEV. (C)	140.61	
F.M. DIAMETER	4-INCH	
INFLUENT SEWER DIAMETER	12-INCH	8-INCH
INFLUENT SEWER ELEV. (D)	I=137.33	I=137.37
HIGH WATER ALARM ELEV. (E)	136.79	
PUMP ON ELEV. (F)	136.29	
PUMP OFF ELEV. (G)	134.29	
LOW WATER ALARM ELEV. (H)	133.79	
PUMP STATION ELEV. (I)	133.01	

* CONTRACTOR TO CONFIRM ELEVATION PRIOR TO STATION FABRICATION.


CLASS 1, DIV. 1 GROUPS C & D
25'
6'-0" DIA. PRECAST CONCRETE VALVE VAULT MANHOLE
6'-0" DIA. PRECAST CONCRETE MANHOLE
SUBMERSIBLE PUMP (TYP.)
MANHOLE RUNG (TYP.)
ELECTRICAL SEAL FITTING (TYP.)
4" DI DISCHARGE (TYP.)
GUIDE BAR (TYP.)
CPLG. (TYP.)
STANDBY GENERATOR
GROUND GRID (TYP.) SEE DETAIL A SHEET 35
1" CONDUIT
CONCRETE BASE FOR ELECT. PEDESTAL CABINET SEE DETAIL SHEET NO. 36
UTILITY POLE SEE DETAIL B SHEET 35
INCOMING ELECTRIC SERVICE FROM UP
1/4 BEND
4"X4" DI TEE
4"X4"-1/8 WYE
4" GATE VALVE
4" RISER PIPE W/FLANGED ADAPTER FOR 4" I.P.T. BRONZE DUST CAP (FOR FUTURE QUICK CONNECTION OF STANDBY PUMP OR PIG LAUNCHER)
4" DI FORCE MAIN
4" CHECK VALVE (TYP.)
4" GATE VALVE (TYP.)
140.70
140.85
138.64
138.42
140.84
140.83
4" DI DRAIN
4" DI DISCHARGE (TYP.)
SEE PIPE CONNECTION DETAIL, SHEET NO. 38
SEWER INFLUENT LINE
4" PVC VENT. VENT, RISER TO BE 6'-0" MIN. FROM ELECTRICAL PEDESTAL CABINET (TYP.)
FLOAT BRACKET (TYP.)
CLASS 1, DIV. 1 GROUPS C & D

PLAN

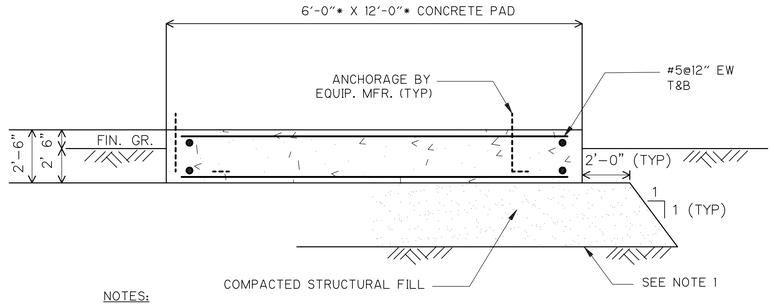
NOTE:
1. SCHEMATIC LAYOUT. SEE SITE PLAN FOR ACTUAL PIPE ORIENTATION.


CLASS 1, DIV. 2 GROUPS C & D
18" ABOVE AND THROUGH AND 36" BEYOND HATCH OPENING HORIZONTALLY
CLASS 1, DIV. 1 GROUPS C & D
CLASS 1, DIV. 2 GROUPS C & D
36" ENVELOPE FROM VENT
ENVELOPE BETWEEN 36" TO 60" FROM VENT
4" PVC VENT
FINISH GRADE ELEV. "B"
3-2" ELECT. CONDUITS
2'-6" x 4'-0" DOUBLE LEAF ACCESS HATCH
6" MIN.
LOAM AND SEED AS SPECIFIED
3'-0" MIN.
24" MIN.
W/INSECT SCREEN
MANHOLE FRAME AND COVER AS SPECIFIED
PAVEMENT AS SPECIFIED
EXIST. GRADE ELEV. "A"
MANHOLE RUNG (TYP.)
7'-0" MIN.
GUIDE BAR (TYP.)
316 STAIN-LESS STEEL LIFT HOOK AND CHAIN
12" DIA. CONC. FOOTING
S.S. FLOAT BRACKET (TYP.)
LIQUID LEVEL SENSOR CABLES/PROBES
SUBMERSIBLE POWER CORD (TYP. OF 2)
CLASS 1, DIV. 1 GROUPS C & D
℄ FORCE MAIN ELEV. "C"
PIPE SUPPORT (TYP.)
SLOPE DOWN 1% MIN.
1'-0" STRUCTURAL FILL (TYP.)
APPROXIMATE SUBGRADE ELEVATION
4" DI DRAIN W/FLAP VALVE
PIPE BRACE
INFLUENT SEWER PIPE INV. EL. "D"
HIGH WATER ALARM ELEV. "E"
PUMP ON ELEV. "F"
4" DI DISCHARGE
SUBMERSIBLE PUMP (TYP. OF 2)
TOP OF CONCRETE FILL
PUMP OFF ELEV. "G"
LOW WATER ALARM ELEV. "H"
CONCRETE FILL
PUMP STATION ELEV. "I"
1'-0" MIN. THICKNESS
REINFORCED CONCRETE FOUNDATION SLAB DESIGNED BY MFG TO RESIST FLOATATION.
1'-0" STRUCTURAL FILL (MIN.)
FILTER FABRIC IN BOTTOM OF EXCAVATION AND EXTENDED 48-IN UP SIDE WALLS

NOTES: 1. PRECASTER TO PROVIDE ADDITIONAL REINFORCEMENT AT CORNERS OF HATCH TO PREVENT PROPAGATION OF CRACKS.

SECTION A
SUBMERSIBLE PUMP STATION

NOT TO SCALE

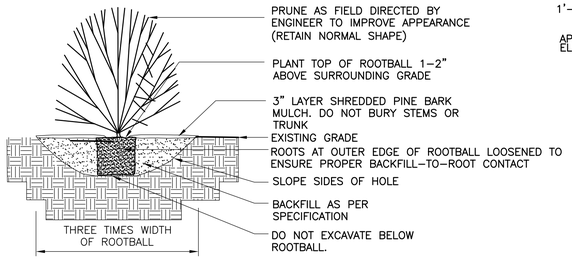


NOTES:

1. FOR GENERATOR PAD, REMOVE ALL COMPRESSIBLE ORGANIC DEPOSITS AND/OR SOIL AND REPLACE WITH STRUCTURAL FILL WITHIN LIMITS SHOWN. EXTEND STRUCTURAL FILL TO 4'-0" BELOW GRADE (MIN.)
2. PROVIDE 3" CLEAR COVER OVER REINFORCING FOR CONCRETE CAST AGAINST SOIL, AND 2" EVERYWHERE ELSE.
3. PROVIDE 3/4" CHAMFER AT EXPOSED CORNERS
4. MINIMUM CONCRETE STRENGTH AT 28 DAYS: 4,000 psi
5. REINFORCING: 6 x 6 WWF
6. * INDICATES DIMENSIONS TO BE COORDINATED BY THE CONTRACTOR W/ APPROVED EQUIPMENT
7. PAD SHOULD EXTEND A MINIMUM 6" WIDER THAN APPROVED EQUIPMENT DIMENSIONS ON ALL SIDES.

GENERATOR PAD DETAIL

NOT TO SCALE


PRUNE AS FIELD DIRECTED BY ENGINEER TO IMPROVE APPEARANCE (RETAIN NORMAL SHAPE)
PLANT TOP OF ROOTBALL 1-2" ABOVE SURROUNDING GRADE
3" LAYER SHREDDED PINE BARK MULCH. DO NOT BURY STEMS OR TRUNK
EXISTING GRADE
ROOTS AT OUTER EDGE OF ROOTBALL LOOSENED TO ENSURE PROPER BACKFILL-TO-ROOT CONTACT
SLOPE SIDES OF HOLE
BACKFILL AS PER SPECIFICATION
DO NOT EXCAVATE BELOW ROOTBALL.
THREE TIMES WIDTH OF ROOTBALL

PLANTING DETAIL

NTS

PLANT LIST (EACH STATION)

QUANTITY	NAME	SIZE	COMMENTS
3	HETZ COLUMNAR JUNIPER-JUNIPERUS CHINENSIS HETZII COLUMNARIS	4-4.5 FT HT	10 GAL CNTR
2	PINUS STROBUS EASTERN WHITE PINE	6-7 FT HT	B & B SPECIMEN FULL BRANCHING
3	PINUS STROBUS EASTERN WHITE PINE	9-10 FT HT	B & B SPECIMEN, BROAD UPRIGHT WITH A CENTRAL LEADER

NOTE:
POSITION TREES AND SHRUBS AND INSTALL LOAM AND SEED AND PINE BARK MULCH AS DIRECTED BY THE ENGINEER.

RECORD DRAWING

REV. NO.	DATE	DRWN	CHKD	REMARKS
1	03/09	EJR	SMK	REVISED FOR RECORD

DESIGNED BY: M. COTE
DRAWN BY: B. GUILFORD
SHEET CHK'D BY: M. GUIDICE
CROSS CHK'D BY: R. SOUPPA
APPROVED BY: R. SOUPPA
DATE: JANUARY 2007

CDM Camp Dresser & McKee Inc.
consulting engineering construction operations

TOWN OF TEWKSBURY, MASSACHUSETTS
SEWERAGE WORKS IMPROVEMENTS
PHASE 9
CONTRACT NO. 31

DEVONSHIRE ROAD
PUMPING STATION DETAILS

PROJECT NO. 0959-44636
FILE NAME: CPSPL001

SHEET NO.
34

ACCESSION NO. 0959-70372

[TEWKSBURY, MA — CONTRACT 31 PHASE 9 SEWER DESIGN] Plotted by: FAVALOROMJ Time: 11/20/2006 11:17:52 AM

Filename: R:\0959\44636\ELEC\ESYMB001.DWG Xref's: [C24X36H,]

SYMBOL	DESCRIPTION
A 3 b	INCANDESCENT, COMPACT FLUORESCENT OR H.I.D. TYPE LIGHTING FIXTURE "A"-FIXTURE TYPE (SEE LIGHTING FIXTURE SCHEDULE) "b"-CONTROLLED BY SWITCH "b" "3"-CIRCUIT NUMBER
A 3 b	FLUORESCENT TYPE LIGHTING FIXTURE NOTATIONS SAME AS ABOVE.
A b 3	WALL OUTLET AND INCANDESCENT COMPACT FLUORESCENT OR H.I.D. LIGHTING FIXTURE. NOTATIONS SAME AS ABOVE.
BU-1 3 (*)	EMERGENCY LIGHTING BATTERY UNIT WITH TWO LAMP HEADS BU-1 = FIXTURE TYPE (SEE LIGHTING FIXTURE SCHEDULE) 3 = SUPERVISORY CIRCUIT (*) = FIXTURE TAG NUMBER
R-2 BU-1(*)	REMOTE ADJUSTABLE EMERGENCY LAMP HEAD * = HOME RUN TO BU INDICATED R-2 - FIXTURE TYPE SEE LIGHTING FIXTURE SCHEDULE
	COMBINATION BATTERY UNIT AND EXIT SIGN
A 3	CEILING MOUNTED EXIT SIGN, NOTATIONS SAME AS ABOVE WHEN USED, ARROW INDICATES DIRECTION OF EGRESS
3	WALL MOUNTED EXIT SIGN, NOTATIONS SAME AS ABOVE WHEN USED, ARROW INDICATES DIRECTION OF EGRESS
	BRANCH CIRCUIT CONDUIT WITH 2#12,1#12G, 3/4"C INSTALLED EXPOSED. FOR MINIMUM SIZE CONDUIT PERMITTED REFER TO THE SPECIFICATIONS. DOES NOT APPLY TO UNDERGROUND DUCTBANKS.
	CONDUIT TURNING UP. COMMENTS SAME AS ABOVE.
	CONDUIT TURNING DOWN
	CONDUIT STUBBED OUT AND CAPPED
	CONDUIT RUN CONCEALED, (2#12, 1#12G, 3/4"C UNLESS OTHERWISE NOTED)
	LIQUIDTITE FLEXIBLE CONDUIT. (2#12, 1#12G., ¾"C. UNLESS OTHERWISE NOTED.)
LP-1 L3	HOMERUN, CIRCUITS 1 AND 3 RUN TO PANEL LP-1
OR LP** LP**	LIGHTING PANELBOARD **-NAME AS INDICATED
OR PP** PP**	POWER PANELBOARD **-NAME AS INDICATED
J J	JUNCTION BOX
P	PULL BOX
¾"C. 2(3#3/0, 1#2G., 3"C.)	CONDUIT, SIZE AND FILL AS NOTED. TWO 3" CONDUITS EACH CONTAINS THREE #3/0 AWG CONDUCTORS AND ONE #2 GROUND.
3#12,1#12G.	THREE (3) NO.12 AWG CONDUCTORS AND ONE (1) NO.12 EQUIPMENT GROUNDING CONDUCTOR
1-2/C#16TS	INSTRUMENT CABLE, TWISTED PAIR OR TRIPLEX AS NOTED WITH OVERALL SHIELD AND JACKET, CONDUCTOR SIZE AND QUANTITY AS NOTED
$a	SINGLE POLE SWITCH, "a" INDICATES CONTROL OF LIGHTS "a" "m" INDICATES MOTOR HORSPOWER RATED.
$ 3 a	THREE WAY SWITCH, "a" INDICATES CONTROL OF LIGHTS "a"
*	DUPLEX RECEPTACLE, 20A, 120V, 3W, SINGLE PHASE * C - MOUNTED ABOVE COUNTER TOP GF - GROUND FAULT INTERRUPTER TYPE WP - WEATHERPROOF 3 - BRANCH CIRCUIT NUMBER T - TRANSIENT VOLTAGE SURGE SUPRESSOR IC - ISOLATED GROUND
* 4	SIMPLEX RECEPTACLE, 120V, 20A, 2P, 3W, NOTATIONS SAME AS ABOVE FOR DUPLEX RECEPTACLE * TL - LOCKING TYPE WP - WEATHERPROOF
* 60 3 4W	SPECIAL PURPOSE RECEPTACLE * = VOLTAGE RATING 3 = NUMBER OF POLES 4W = WIRES IN ADDITION TO GROUND 60 = AMPERE RATING
K	TELEPHONE OUTLET FOR DESK TYPE HANDSET K = KEY SWITCH
K	TELEPHONE OUTLET FOR WALL TYPE HANDSET (MOUNT UP 4'-6") K = KEY SWITCH
	PAGE/PARTY TELEPHONE OUTLET FOR DESK TYPE HANDSET
	PAGE/PARTY TELEPHONE OUTLET FOR WALL TYPE HANDSET (MOUNT UP 4'-6")
TM	TELEPHONE CABINET OR BACKBOARD AS SPECIFIED
C	LIGHTING CONTACTOR, MECHANICALLY HELD TYPE
DM	DAMPER MOTOR
PC	PHOTOCELL
F	FIRE ALARM MANUAL PULL STATION, MOUNT UP 4'-0"
H 200 R	HEAT ACTUATED FIRE DETECTOR 200 = 200°F FIXED TEMP R = FIXED TEMP, RATE-OF-RISE TYPE
1 I	SMOKE DETECTOR PHOTOELECTRIC TYPE UNLESS OTHERWISE NOTED. I = IONIZATION TYPE D = DUCT SMOKE DETECTOR
S	PAGING SPEAKER FLUSH MOUNTED. CEILING TYPE
S	PAGING SPEAKER SURFACE MOUNTED. CEILING TYPE
WS	SECURITY ALARM WINDOW SWITCH
F 15	FIRE ALARM STROBE, MOUNT UP 6'-8". NUMERAL INDICATES CANDELA RATING
F 15	FIRE ALARM HORN AND STROBE LIGHT COMBINATION. MOUNT UP 6'-8". NUMERAL INDICATES CANDELA RATING
SFS	SPRINKLER FLOW ALARM SWITCH
FACP	FIRE ALARM CONTROL PANEL
SACP	SECURITY ALARM CONTROL PANEL
FB	WEATHERPROOF HI-INTENSITY FIRE ALARM STROBE LIGHT
VSS	SPRINKLER VALVE SUPERVISORY SWITCH
DS	SECURITY ALARM DOOR SWITCH
GB	GLASS BREAK DETECTOR
K	SECURITY ALARM KEY PAD
	SECURITY ALARM MOTION DETECTOR
	INDICATES MOTOR STARTER OR MOTOR CONTROL EQUIPMENT WITHIN THE ENCLOSURE
ESA	EYE WASH SHOWER ALARM STATION
R	SECURITY ALARM CARD ACCESS READER
S HI W	PAGING SPEAKER WALL MOUNTED HI = HORN TYPE W = WIDE ANGLE TYPE
L	FIRE ALARM SMOKE DETECTOR REMOTE INDICATOR AND TEST SWITCH
	EXOTHERMIC WELD CONNECTION

ONE LINE OR CONTROL DIA.	PLAN	DESCRIPTION
FRAME TRIP	CB	LOW VOLTAGE CIRCUIT BREAKER, THREE POLE UNLESS NOTED OTHERWISE
*	*	COMBINATION MOTOR CIRCUIT PROTECTOR AND MAGNETIC MOTOR STARTER, FULL VOLTAGE NON-REVERSING UNLESS NOTED OTHERWISE. * FVR - FULL VOLTAGE REVERSING RVNR - REDUCED VOLTAGE NON-REVERSING 2SW - TWO SPEED, ONE WINDING 2SDW - TWO SPEED, TWO WINDING RVAT-REDUCED VOLTAGE AUTO TRANSFORMER
*	*	NON-FUSIBLE DISCONNECT SWITCH, 600 VOLT, 3 POLE * AMPERE RATING NOTED IF OTHER THAN 30A
SWITCH FUSE	F *	FUSIBLE DISCONNECT SWITCH, 600 VOLT, 3 POLE AMPERE RATING AND FUSE SIZE AS NOTED
	P 2	MANUAL MOTOR STARTER WITH THERMAL OVERLOAD HEATER P - PILOT LIGHT 2 - 2 POLES
	T	TRANSFORMER, RATING AND CONNECTIONS AS NOTED
* A TO 5	—	CURRENT TRANSFORMER * QUANTITY A = PRIMARY AMPERES
V-120 *	—	POTENTIAL TRANSFORMER * QUANTITY V = PRIMARY VOLTS
LA	—	LIGHTNING ARRESTER
*	—	SPECIAL CAPACITOR SC SURGE CAPACITOR PF POWER FACTOR CORRECTION CAPACITOR
	G	GROUND OR GROUND ROD
30A	—	FUSE, AMPERE RATING AS NOTED
5	M	MOTOR, NUMERAL INDICATES HORSEPOWER
Y	G	GENERATOR, RATINGS AND CONNECTIONS AS NOTED
TG	TG	TACHOMETER GENERATOR
VS VM *	—	VOLTMETER WITH SWITCH, 3 PHASE * RANGE AS NOTED
AS AM *	—	AMMETER WITH SWITCH, 3 PHASE * RANGE AS NOTED
*	—	METER - INDICATING/RECORDING TYPE * WM - WATTMETER WHM - WATTHOUR METER WHDM - WATTHOUR DEMAND METER PF - POWER FACTOR METER ETM - RUNNING TIME METER TRANSDUCER * AX - CURRENT TRANSDUCER WX - WATT TRANSDUCER WHX - WATT WATTHOUR TRANSDUCER
	—	PROTECTIVE RELAY, NO. AS INDICATED: 27 - UNDERVOLTAGE RELAY 38 - BEARING PROTECTIVE DEVICE 42 - RUNNING CIRCUIT BREAKER OR CONTACTOR 46 - REVERSE PHASE, OR PHASE BALANCE, CURRENT RELAY 47 - PHASE SEQUENCE VOLTAGE RELAY 49 - MACHINE OR TRANSFORMER THERMAL RELAY 50 - INSTANTANEOUS OVERCURRENT, OR RATE-OF-RISE RELAY 50G- INSTANTANEOUS GROUND RELAY, ZERO SEQUENCE 51 - AC TIME OVERCURRENT RELAY 51N- AC TIME OVERCURRENT RELAY , RESIDUAL TYPE 86 - LOCKING-OUT RELAY 87 - DIFFERENTIAL PROTECTIVE RELAY
#KW OR #KW	E	UNIT HEATER - ELECTRIC HEATING COIL AND FAN # = RATING
—	U	UNIT HEATER - STEAM OR WATER HEATING COIL AND FAN
K	—	KEY INTERLOCK
TB	—	VOLTAGE OR CURRENT TEST BLOCK
	—	MECHANICAL CONNECTION OR INTERLOCK
	—	CONDUCTORS OR CONDUITS CROSSING PATHS BUT NOT CONNECTED
	—	CONDUCTORS ELECTRICALLY CONNECTED
	—	INDICATES LIMITS OF EQUIPMENT OR WIRING ENCLOSURE
	—	PUSHBUTTON, MOMENTARY CONTACT, SPRING RETURN , NORMALLY CLOSED
	—	PUSHBUTTON, MOMENTARY CONTACT, SPRING RETURN NORMALLY OPEN
	ES	EMERGENCY STOP PUSHBUTTON WITH RED MUSHROOM HEAD OPERATOR , MAINTAINED CONTACT, PUSH-TO-STOP PULL TO RESET.
	PBL	START-STOP PUSHBUTTON CONTROL STATION (MOMENTARY CONTACT) WITH LOCKOUT DEVICE ON STOP
	PBM	START-STOP PUSHBUTTON CONTROL STATION, MAINTAINED CONTACT WITH LOCKOUT DEVICE ON STOP
A B * (XO) (0X)	LR	TWO POSITION SELECTOR SWITCH, MAINTAINED CONTACT POSITION | 1-CONTACT | 2-CONTACT A | X | 0 B | 0 | X X-CLOSED 0-OPEN * NAMEPLATE (A/B) LR - LOCAL/REMOTE
A B C * (XOO) (0OX)	HOA LOR RSL	THREE POSITION SELECTOR SWITCH, MAINTAINED CONTACT POSITION | 1-CONTACT | 2-CONTACT | 3-CONTACT A | X | 0 | — B | 0 | 0 | — C | 0 | X | — X-CLOSED 0-OPEN * NAMEPLATE (A/B/C) HOA - HAND/OFF/AUTO LOR - LOCAL/OFF/REMOTE RSL - RAISE/STOP/LOWER HOR - HAND/OFF/REMOTE TOA - TEST/OFF/AUTO
BY DIV. 16 MO M BY OTHERS	BY DIV. 16 MO M BY OTHERS	MOTOR OPERATED GATE OR VALVE.
CS	CS	MOTOR OPERATED REMOTE CONTROL STATION.
		CABLE SEAL AND EXPLOSION PROOF SEAL FITTING
100 A ATS-I N S	—	AUTOMATIC OR MANUAL TRANSFER SWITCH NO. 1 (ATS-1) (MTS-1) "N" INDICATES NORMAL OR PREFERRED SOURCE "S" INDICATES STAND BY OR ALTERNATE SOURCE 100 A INDICATES CONTINUOUS CURRENT RATING

ONE LINE OR CONTROL DIA.	PLAN	DESCRIPTION
	LS OR ■	LIQUID LEVEL (FLOAT) SWITCH NORMALLY OPEN, CLOSES ON RISING LEVEL NORMALLY CLOSED, OPENS ON RISING LEVEL
	PS OR ■	PRESSURE OR VACUUM SWITCH NORMALLY OPEN, CLOSES ON RISING PRESSURE NORMALLY OPEN, CLOSES ON DROPPING PRESSURE NORMALLY CLOSED, OPENS ON RISING PRESSURE NORMALLY CLOSED, OPENS ON DROPPING PRESSURE
	TS OR T OR ■	TEMPERATURE ACTUATED SWITCH (THERMOSTAT) NORMALLY OPEN, CLOSES ON RISING TEMPERATURE NORMALLY OPEN, CLOSES ON DROPPING TEMPERATURE NORMALLY CLOSED, OPENS ON RISING TEMPERATURE NORMALLY CLOSED, OPENS ON DROPPING TEMPERATURE
	FS OR ■	FLOW SWITCH (AIR, WATER, ETC.) NORMALLY OPEN, CLOSES ON INCREASED FLOW NORMALLY CLOSED, OPENS ON INCREASED FLOW
	ZS OR ■	POSITION (LIMIT) SWITCH NORMALLY OPEN - HELD CLOSED NORMALLY OPEN NORMALLY CLOSED - HELD OPEN NORMALLY CLOSED
SV	SV	SOLENOID OPERATED VALVE
	HTR	STRIP HEATER OR HEATING ELEMENT
	SCV	SURGE CONTROL VALVE
	—	PILOT LIGHT, COLOR AS NOTED * R - RED G - GREEN A - AMBER B - BLUE W - WHITE
	—	PILOT LIGHT, PUSH TO TEST TYPE * COLOR AS NOTED ABOVE
CR	—	RELAY COIL, NUMBER AS INDICATED
M	—	MOTOR STARTER COIL, NUMBER AS INDICATED
	—	CONTACT, NORMALLY OPEN (NO)
	—	CONTACT, NORMALLY CLOSED (NC)
	—	OVERLOAD RELAY HEATER (OL)
TD 0-60 SEC	—	TIME DELAY RELAY, RANGE AS NOTED SET POINT AS NOTED TDE-TIME DELAY AFTER ENERGIZATION-ON DELAY TDD-TIME DELAY AFTER DE-ENERGIZATION-OFF DELAY NOTC - NORMALLY OPEN, TIMED CLOSE WHEN ENERGIZED NCTO - NORMALLY CLOSED, TIMED OPEN WHEN ENERGIZED NOTO - NORMALLY OPEN, TIMED OPEN WHEN DE-ENERGIZED NCTC - NORMALLY CLOSED, TIMED CLOSE WHEN DE-ENERGIZED
RTD	—	RESISTANCE TEMPERATURE DETECTOR
—	* —##	FIELD INSTRUMENT, TAG NO. AS INDICATED ## - INDICATES LOOP NO. * - INDICATES INSTRUMENT TYPE DEFINED ON LOOP SHEETS OR P & ID
#	—	UTILIZED WITH OTHER CONTROL SCHEMATIC SYMBOLS TO DEPICT THE PHYSICAL LOCATION OF THE DEVICE # REPRESENTS SEE LOCATION LEGEND ON DRAWINGS
		INDICATED EQUIPMENT AND MATERIALS TO BE DEMOLISHED
VE OR VE	—	VIBRATION DETECTOR
ETM	—	ELAPSED TIME METER
—	DM	DAMPER MOTOR
TYPE A		INDICATES THAT ALL LUMINAIRES WITHIN THE ROOM OR AREA IN WHICH THIS NOTATION APPEARS SHALL BE TYPE "A" UNLESS OTHERWISE NOTED
DAMP		INDICATES THAT ALL ELECTRICAL EQUIPMENT AND MATERIALS INSTALLED WITHIN THE ROOM OR AREA IN WHICH THIS NOTATION APPEARS SHALL BE OF NEMA 12 CONSTRUCTION AND SUITABLE FOR USE IN A DAMP OR WET LOCATION
WET		INDICATES THAT ALL ELECTRICAL EQUIPMENT AND MATERIALS INSTALLED WITHIN THE ROOM OR AREA IN WHICH THIS NOTATION APPEARS SHALL BE OF WATERTIGHT OR NEMA 4 CONSTRUCTION SUITABLE FOR USE IN A WET LOCATION, UNLESS NOTED OTHERWISE
CORROSIVE		INDICATES THAT ALL ELECTRICAL EQUIPMENT AND MATERIALS INSTALLED WITHIN THE ROOM OR AREA IN WHICH THIS NOTATION APPEARS SHALL BE OF NEMA 4X, CORROSION RESISTANT CONSTRUCTION SUITABLE FOR USE IN A WET LOCATION, UNLESS NOTED OTHERWISE
CLASS 1, DIV. 1, GROUP D		INDICATES THAT ALL ELECTRICAL EQUIPMENT AND INSTALLATION WITHI THE ROOM OR AREA IN WHICH THIS NOTATION APPEARS_____SHALL CONFORM TO N.E.C. REQUIREMENTS FOR THE HAZARDOUS AREA CLASSIFICATION SHOWN
GD/VF #	GD/VF #	GAS DETECTOR/VENTILATION FAILURE ALARM. # INDICATES TYPE OF UNIT. 1 = MASTER, 2 = REMOTE

ABBREVIATIONS

A	AMPS OR AMPERE	LV	LOW VOLTAGE
AC	ALTERNATING CURRENT	MAX	MAXIMUM
AFF	ABOVE FINISHED FLOOR	MCC	MOTOR CONTROL CENTER
AFG	ABOVE FINISHED GRADE	MCP	MOTOR CIRCUIT PROTECTOR
AIC	AMPERE INTERRUPTING CAPACITY	MFR	MANUFACTURER
ANNUN.	ANNUNCIATOR	MH	MANHOLE
ATS	AUTOMATIC TRANSFER SWITCH	MIN	MINIMUM
AUTO	AUTOMATIC	MLO	MAIN LUGS ONLY
AUX	AUXILIARY	MMU	MICROPROCESSOR METERING UNIT
BC	BARE COPPER	MTG	MOUNTING
BKR	BREAKER	MTD	MOUNTED
BLDG	BUILDING	MTS	MANUAL TRANSFER SWITCH
C	CONDUIT	MV	MEDIUM VOLTAGE
CB	CIRCUIT BREAKER	N	NEUTRAL
CKT	CIRCUIT	NC	NORMALLY CLOSED
CLF	CURRENT LIMITING FUSE	NIC	NOT IN CONTRACT
CP	CONTROL PANEL	NO	NORMALLY OPEN OR NUMBER
CPT	CONTROL POWER TRANSFORMER	NTS	NOT TO SCALE
CR	CONTROL RELAY	OH	OVERHEAD
CS	CONTROL SWITCH	P	PULL BOX
CT	CURRENT TRANSFORMER	OL	OVERLOAD
CU	COPPER	PCP	PUMP CONTROL PANEL
CWS	CONDUIT WALL SEAL	PH	PHASE
DC	DIRECT CURRENT	PNL	PANEL OR PANELBOARD
DIA	DIAMETER	PR	PAIR
DMU	DIGITAL METERING UNIT	PRI	PRIMARY
DN	DOWN	PT	POTENTIAL TRANSFORMER
EGC	EQUIPMENT GROUNDING CONDUCTOR	PVC	POLYVINYL CHLORIDE
ELEC	ELECTRICAL	QTY	QUANTITY
ELEV	ELEVATION	RECPT	RECEPTACLE
EM	EMERGENCY	REQD	REQUIRED
ENCL	ENCLOSURE OR ENCLOSED	SA	SURGE ARRESTER
EQUIP	EQUIPMENT	SC	SURGE CAPACITOR
EWC	ELECTRIC WATER COOLER	SEC	SECONDS OR SECONDARY
EWH	ELECTRIC WATER HEATER	SH	SHIELDED
EX	EXISTING	SHH	SIGNAL HANDHOLE
FBO	FURNISHED BY OTHERS	SHT	SHEET
FO	FIBER OPTIC	SN	SOLID NEUTRAL
FRP	FIBERGLASS REINFORCED POLYESTER	SS	STAINLESS STEEL
FU	FUSE	SV	SOLENOID VALVE
GCP	GENERATOR CONTROL PANEL	SW	SWITCH
GEN	GENERATOR	SWBD	SWITCHBOARD
G , GRD	GROUND	SWGR	SWITCHGEAR
GB	GROUND BAR	TC	TIME TO CLOSE OR TRAY CABLE
GFI	GROUND FAULT INTERRUPTER	TEL	TELEPHONE
GRS	GALVANIZED RIGID STEEL	THH	TELEPHONE HANDHOLE
HH	HANDHOLE	TPA	TRANSFORMER PANEL ASSEMBLE
HP	HORSEPOWER	TVSS	TRANSIENT VOLTAGE SURGE SUPRESSOR
HT	HEIGHT	TS	TWISTED SHIELDED
HZ	HERTZ	TYP	TYPICAL
INST	INSTANTANEOUS	UG	UNDERGROUND
INSTR	INSTRUMENT OR INSTRUMENTATION	UON	UNLESS OTHERWISE NOTED
KCMIL	1000 CIRCULAR MILS	V	VOLTS
LA	LIGHTNING ARRESTER	VFD	VARIABLE FREQUENCY DRIVE
LBS	LOAD BREAK SWITCH	W	WIRE, WATTS, WITH, WIDTH
LGTS	LIGHTS	WP	WEATHERPROOF
LTG	LIGHTING	XP	EXPLOSION PROOF
LP	LIGHTING PANEL	XFMR	TRANSFORMER

NOTES:

1. THE WIRING DIAGRAMS, QUANTITY AND SIZE OF WIRES AND CONDUIT REPRESENT A SUGGESTED ARRANGEMENT BASED UPON SELECTED STANDARD COMPONENTS OF ELECTRICAL EQUIPMENT. MODIFICATIONS ACCEPTABLE TO THE ENGINEER MAY BE MADE BY THE CONTRACTOR TO ACCOMODATE EQUIPMENT ACTUALLY PURCHASED. THE BASIC SEQUENCE AND METHOD OF CONTROL MUST BE MAINTAINED AS INDICATED ON THE DRAWINGS AND/OR SPECIFICATIONS.

SHEET NO. WHERE DETAIL IS DRAWN → A / E-2

SYMBOL WHERE THERE IS A DETAIL

SUBTITLE

DETAIL A / E-5

1" = 1"

SHEET NO. WHERE THERE IS A DETAIL

SYMBOL WHERE DETAIL IS DRAWN

DETAIL SYMBOL

SHEET NO. WHERE SECTION IS DRAWN → 3 / E-5

SYMBOL WHERE THERE IS A SECTION

SUBTITLE

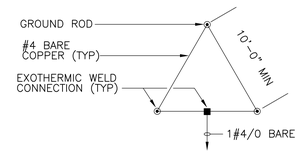
SECTION 3 / E-4

1" = 1"

SHEET NO. WHERE SECTION IS TAKEN

SYMBOL WHERE SECTION IS DRAWN

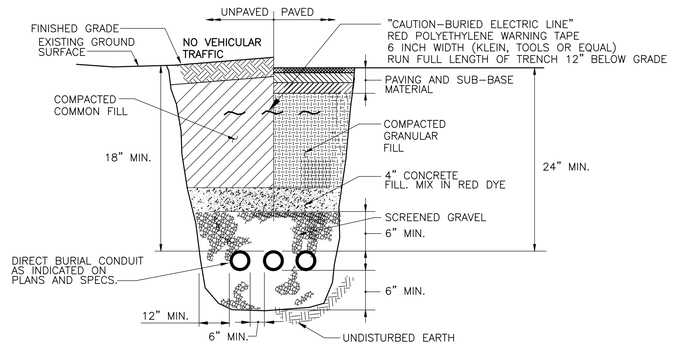
SECTION SYMBOL



GROUND GRID

DETAIL A / 34

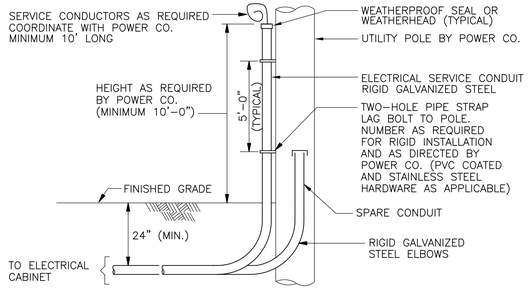
N.T.S.



DIRECT BURIAL CONDUIT DETAIL

DETAIL C / 34

N.T.S.


SERVICE CONDUCTORS AS REQUIRED COORDINATE WITH POWER CO. MINIMUM 10' LONG
WEATHERPROOF SEAL OR WEATHERHEAD (TYPICAL)
UTILITY POLE BY POWER CO.
ELECTRICAL SERVICE CONDUIT RIGID GALVANIZED STEEL
HEIGHT AS REQUIRED BY POWER CO. (MINIMUM 10'-0")
5'-0" (TYPICAL)
TWO-HOLE PIPE STRAP LAG BOLT TO POLE. NUMBER AS REQUIRED FOR RIGID INSTALLATION AND AS DIRECTED BY POWER CO. (PVC COATED AND STAINLESS STEEL HARDWARE AS APPLICABLE)
FINISHED GRADE
SPARE CONDUIT
24" (MIN.)
RIGID GALVANIZED STEEL ELBOWS
TO ELECTRICAL CABINET

TYPICAL UTILITY POLE DETAIL

DETAIL B / 34

N.T.S.

GENERAL NOTE

THIS IS A STANDARD LEGEND. SOME SYMBOLS MAY NOT APPEAR ON THE DRAWINGS.

NOTE

REFER TO OPERATION AND MAINTENANCE MANUAL FOR ACTUAL INSTALLED MATERIALS AND EQUIPMENT

RECORD DRAWING

REV. NO.	DATE	DRWN	CHKD	REMARKS
1	03/09	EJR	SMK	REVISED FOR RECORD

DESIGNED BY: M. FAVALORO
DRAWN BY: M. FAVALORO
SHEET CHK'D BY: B. SQUIBB
CROSS CHK'D BY: R. SOUPPA
APPROVED BY: R. SOUPPA
DATE: JANUARY 2007

CDM Camp Dresser & McKee Inc.
consulting engineering construction operations

TOWN OF TEWKSBURY, MASSACHUSETTS
SEWERAGE WORKS IMPROVEMENTS
PHASE 9
CONTRACT NO. 31

ELECTRICAL SYMBOLS, ABBREVIATIONS, AND DETAILS

PROJECT NO. 0959-44636
FILE NAME: ESYMB001

SHEET NO. 35

ACCESSION NO. 0959-70373

[TEWKSBURY, MA – CONTRACT 31 PHASE 9 SEWER DESIGN] Xref's: [C24X36H,] Plotted by: FAVALOROMJ Time: 1/29/2007 3:19:18 PM
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EQUIPMENT LIST

ITEM NO.		DESCRIPTION	MANUFACTURER
1		METER SOCKET WITH BONDED NEUTRAL AND MANUAL LEVER BYPASS	SQUARE D OR EQUAL
2		SERVICE ENTRANCE RATED MAIN CIRCUIT BREAKER	SQUARE D OR EQUAL
3		NEMA 3R TYPE ENCLOSURE WITH GASKETED OVERLAPPING DOORS WITHOUT CENTER POST, STEEL 3 POINT LATCHING MECHANISM AND KEY–LOCKING HARDWARE. CONTRACTOR IS RESPONSIBLE FOR COORDINATING EXACT DIMENSIONS OF CABINET WITH EQUIPMENT FURNISHED IN THE FIELD.	HOFFMAN OR EQUAL
4		SECONDARY LIGHTNING ARRESTER AND SURGE CAPACITOR	G.E. OR EQUAL
5		AUTOMATIC TRANSFER SWITCH, 200 AMP, 2 POLE (WITH SOLIDLY CONNECTED NEUTRAL), 240 VOLT, 1 PHASE, 3 WIRE, NEMA 1 ENCLOSURE WITH EQUIPMENT GROUND BUS DOUBLE LUGS AND LOSS OF POWER CONTACTS. PROVIDE INDICATING VOLTMETER TO INDICATE POWER OUTAGE.	ASCO, RUSSELL CO. OR EQUAL
6		PUMP CONTROL PANEL WITH DUAL MOTOR STARTERS AND CONTROLS FURNISHED UNDER DIVISION 11, INSTALLED UNDER DIVISION 16.	–
7		125A GENERATOR CIRCUIT BREAKER RATED AS SERVICE ENTRANCE	BY GENERATOR MANUFACTURER
8	A	OUTLET BOX AND COVER WITH GFIC DUPLEX RECEPTACLE	HUBBELL OR EQUAL
	B	100 WATTS, 120 VOLT STRIP HEATER (FRONT AND BACK) WITH THERMOSTAT SET TO VOID CONDENSATION.	CHROMALOX OR EQUAL
	C	OUTLET BOX AND COVER WITH DUPLEX RECEPTACLE	FURNISHED BY GENERATOR MANUFACTURER
	D	SINGLE POLE SWITCH, 20 A, 120 V, GROUNDING TYPE BROWN WITH SINGLE GANG OUTLET BOX AND COVER	HUBBELL OR EQUAL
9		GROUND BUS WITH SET–SCREW TERMINALS (SEE CONNECTIONS INDICATED ON SINGLE LINE DIAGRAM.)	SQUARE D OR EQUAL
10		THREE GROUND RODS 10–'0" LONG X 3/4" DIAMETER. TOP OF RODS 18" BELOW FINISHED GRADE SPACED 20 FEET APART. SEE DETAILS.	CAROLINA OR EQUAL
11		CABINET EXHAUST FAN	CABINET VENDOR OPTION
12		MAGNETIC DOOR CONTACTS FOR CONNECTION TO INTRUSION ALARM SYSTEM BY OTHERS.	ADT OR EQUAL
13		120/240 VOLT, 100 AMP, 1 PHASE, 3 WIRE, 12 POLE PANELBOARD, MAIN BREAKER AND BRANCH CIRCUITS AND GROUND BUS AS INDICATED	SQUARE D OR EQUAL
14		AUTOMATIC TELEPHONE DIALER, PROVIDE 120 VOLTS FROM PANELBOARD (ITEM 13)	MISSION OR EQUAL
15		AS RECOMMENDED BY ITEM 5 SURGE ARRESTOR MANUFACTURER, PROVIDE FUSE IN NEMA TYPE 1 ENCLOSURE	BUSSMANN, SHAWMUT, OR EQUAL
16		EMERGENCY GENERATOR SHUTDOWN MUSHROOM HEAD PUSHBUTTON SWITCH WITH MAINTAINED CONTACT. PROVIDE YELLOW NAME PLATE ENGRAVED "GENERATOR EMERGENCY SHUTDOWN"	BUSSMANN, SHAWMUT, OR EQUAL
17		INCANDESCENT LIGHT FIXTURE, 150 WATT WITH LENS CATALOG NUMBER VC 10 756–A	APPLETON OR EQUAL

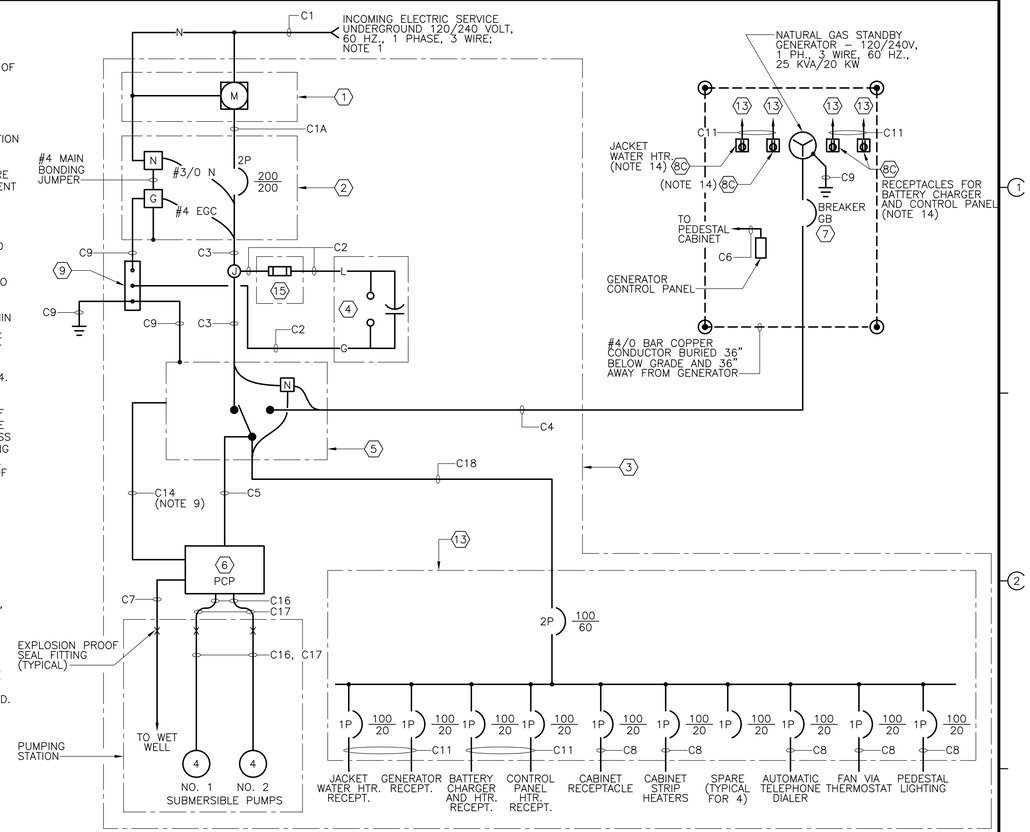
WIRING SCHEDULE

CONDUIT TAG	CONDUIT SIZE	WIRE QTY.	WIRE SIZE	REMARKS
C1	2.5"	3	#3/0	240 VOLT SERVICE FEEDER FROM UTILITY COMPANY
C1A	2.5"	3	#3/0	MAIN FEEDER (SERVICE FEEDER)
C2	3/4"	3 1	#10 #8G	SURGE ARRESTER WITH 3 LINES AND GROUND LEADS
C3	2.5"	3 1	#3/0 #4G	ATS NORMAL POWER FEEDER
C4	2"	3 1	#1/0 #6	ATS GENERATOR FEEDER
C5	1.5"	3 1	#1/0 #6	ATS TO PCP
C6	2"	20	#14	GENERATOR CONTROL PANEL
C7	1"	1	–	LEVEL CONTROL CABLE(S) FURNISHED UNDER DIVISION 11, INSTALLED UNDER DIVISION 16
C8	3/4"	2 1	#12 #12G	120 VOLT BRANCH CIRCUIT WIRING
C9	3/4"	1	#6	GROUNDING ELECTRODE CONDUCTOR
C10	2"	20	#14	CONTROLS FROM PCP TO TELEPHONE DIALER
C11	1"	4 1	#10 #10G	120 VOLT BRANCH CIRCUIT WIRING
C12	1"	6	#14	EMERGENCY STOP TO GENERATOR CONTROL PANEL
C13	1"	12	#14	FROM GENERATOR CONTROL PANEL
C14	3/4"	4	#14	INTERLOCKS
C15	3/4"	2 1	#12 #12G	GENERATOR CONTROL PANEL FEEDER
C16	1.5"	1	–	SUBMERSIBLE PUMP MOTOR POWER CABLE FURNISHED UNDER DIVISION 11, INSTALLED UNDER DIVISION 16 (EQUIPMENT VENDOR MAY FURNISH C16 AND C17 AS ONE CABLE)
C17	1.5"	1	–	SUBMERSIBLE PUMP MOTOR THERMAL AND MOISTURE PROTECTION CABLE FURNISHED UNDER DIVISION 11, INSTALLED UNDER DIVISION 16. ROUTE CABLE IN CONDUIT C16. (EQUIPMENT VENDOR MAY FURNISH C16 AND C17 AS ONE CABLE)
C18	1.5"	3 1	#1/0 #6G	ATS TO PANELBOARD
S1	3"	–	–	SPARE TO UTILITY RISER POLE
S2	2"	–	–	SPARE TO WET WELL
S3	2"	–	–	SPARE TO STANDBY GENERATOR

NOTES:

1. SEE EQUIPMENT LOCATION ON SITE PLAN, SHEET 34.
2. ALL WORK SHALL CONFORM TO THE LATEST EDITION OF STATE AND LOCAL ELECTRICAL CODES. PROVIDE ALL EQUIPMENT GROUNDS AS INDICATED.
3. THE LOCATION OF PULLBOXES FOR ALL POWER AND CONTROL WIRING TERMINATIONS AT THE PUMPING STATION SHALL BE COORDINATED WITH PUMPING STATION MANUFACTURER.
4. SIZE AND/OR ARRANGEMENT OF PEDESTAL ENCLOSURE SHALL BE MODIFIED AS NECESSARY TO SUIT EQUIPMENT ACTUALLY FURNISHED.
5. PROVIDE BLACK LAMINATED NAMEPLATES WITH WHITE LETTERING ENGRAVED AS INDICATED ON ELEVATIONS. ALSO PROVIDE YELLOW SIGN READING "WARNING" AND "KEEP OUT – 240 VOLTS INSIDE."
6. BOND ALL ENCLOSURES LOCATED WITHIN PEDESTAL TO GROUND BUS.
7. PROVIDE LIQUID TIGHT FLEXIBLE METAL CONDUIT WITHIN PEDESTAL CABINET. PROVIDE RIGID GALVANIZED STEEL CONDUIT BETWEEN PEDESTAL CABINET AND BOTH THE WET WELL AND UTILITY POLE.
8. SEE HAZARDOUS AREA CLASSIFICATIONS ON SHEET 34.
9. THE ATS CONTROL CIRCUIT INTERLOCKS SHALL BE WIRED TO THE PUMP CONTROL CIRCUIT TO SHUT OFF PUMP PRIOR TO TRANSFER IN EITHER DIRECTION. THE PUMP CONTROL PANEL SHALL INCLUDE A POWER LOSS RELAY. THIS RELAY SHALL SHUT DOWN PUMPS DURING THE LOSS OF POWER AT THE PUMP CONTROL PANEL AND ALLOW PUMPS TO RESTART AFTER A MINIMUM OF 15 SEC. DELAY AFTER THE POWER IS RESTORED.
10. PROVIDE EXPLOSION PROOF SEALS ON BOTH ENDS (WETWELL AND PEDESTAL CABINET)
11. ALL ELECTRICAL EQUIPMENT SHALL BE RATED TO WITHSTAND SHORT CIRCUIT CURRENT OF 22 KA RMS MINIMUM OR AS SPECIFIED.
12. PROVIDE PANEL SUPPORT MOUNTED IN CONCRETE FLOOR OF PEDESTAL CABINET FOR PANELBOARD, ATS, AND PUMP CONTROL PANEL.
13. MISSION COMMUNICATION MODEL 110 WIRELESS MONITORING AND ALARM UNIT.
14. ELECTRICAL CONTRACTOR TO RUN CONDUIT AND WIRE TO RECEPTACLE PROVIDED BY GENERATOR MANUFACTURER. VERIFY EXACT LOCATION IN THE FIELD.

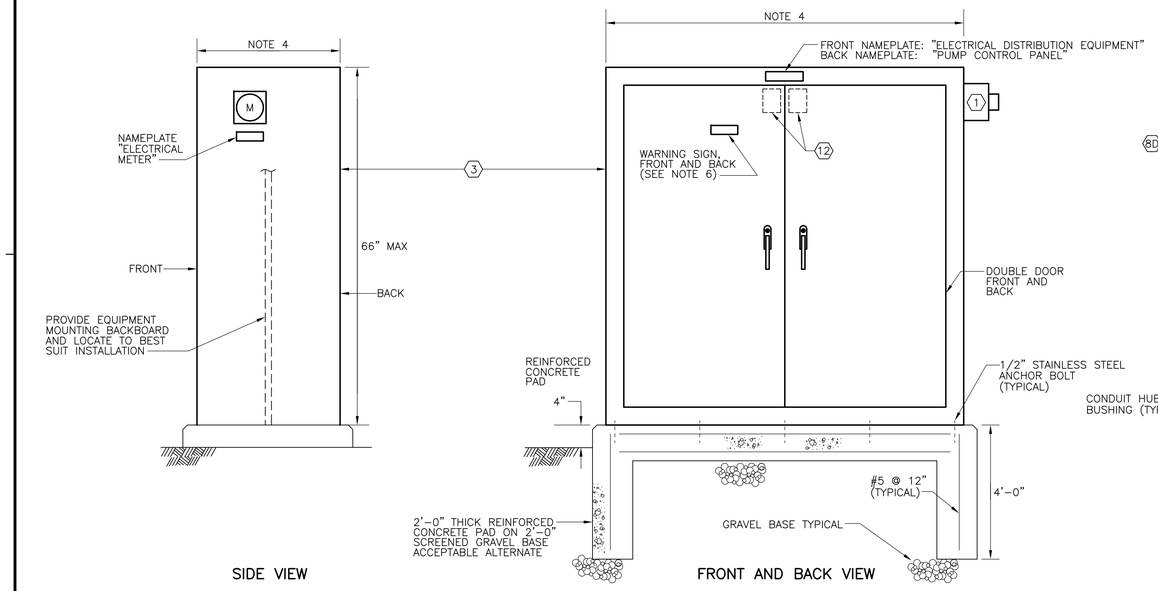
NOTE
REFER TO OPERATION AND MAINTENANCE MANUAL FOR ACTUAL INSTALLED MATERIALS AND EQUIPMENT


INCOMING ELECTRIC SERVICE UNDERGROUND 120/240 VOLT, 60 HZ., 1 PHASE, 3 WIRE; NOTE 1
#4 MAIN BONDING JUMPER
#3/0 N
#4 EGC
2P 200 200
NATURAL GAS STANDBY GENERATOR – 120/240V, 1 PH., 3 WIRE, 60 HZ., 25 KVA/20 KW
JACKET WATER HTR. (NOTE 14)
(NOTE 14)
TO PEDESTAL CABINET
GENERATOR CONTROL PANEL
BREAKER GB
RECEPTACLES FOR BATTERY CHARGER AND CONTROL PANEL (NOTE 14)
#4/0 BAR COPPER CONDUCTOR BURIED 36" BELOW GRADE AND 36" AWAY FROM GENERATOR
EXPLOSION PROOF SEAL FITTING (TYPICAL)
PCP
TO WET WELL
PUMPING STATION
NO. 1 SUBMERSIBLE PUMPS
NO. 2
2P 100 60
1P 100 20
JACKET WATER HTR. RECEPT.
GENERATOR RECEPT.
BATTERY CHARGER AND HTR. RECEPT.
CONTROL PANEL HTR. RECEPT.
CABINET RECEPTACLE
CABINET STRIP HEATERS
SPARE (TYPICAL FOR 4)
AUTOMATIC TELEPHONE DIALER
FAN VIA THERMOSTAT
PEDESTAL LIGHTING

OUTDOOR PAD MOUNTED ELECTRICAL CABINET

ONE LINE DIAGRAM

N.T.S.

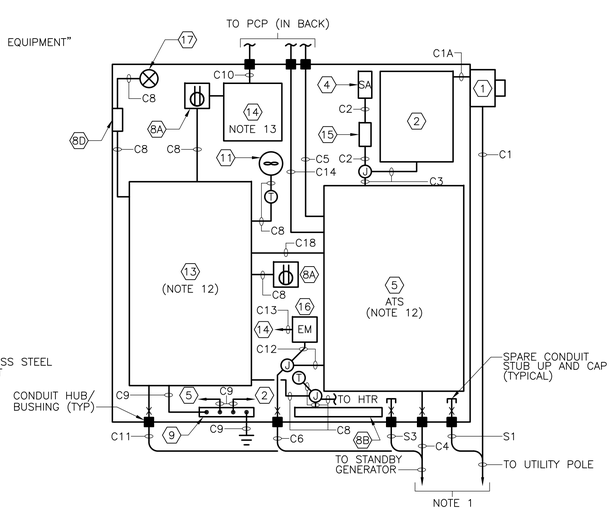

NOTE 4
NAMEPLATE "ELECTRICAL METER"
66" MAX
FRONT
BACK
PROVIDE EQUIPMENT MOUNTING BACKBOARD AND LOCATE TO BEST SUIT INSTALLATION
NOTE 4
FRONT NAMEPLATE: "ELECTRICAL DISTRIBUTION EQUIPMENT"
BACK NAMEPLATE: "PUMP CONTROL PANEL"
WARNING SIGN, FRONT AND BACK (SEE NOTE 6)
DOUBLE DOOR FRONT AND BACK
REINFORCED CONCRETE PAD
4"
1/2" STAINLESS STEEL ANCHOR BOLT (TYPICAL)
#5 @ 12" (TYPICAL)
4'–0"
2'–0" THICK REINFORCED CONCRETE PAD ON 2'–0" SCREENED GRAVEL BASE ACCEPTABLE ALTERNATE
GRAVEL BASE TYPICAL

SIDE VIEW

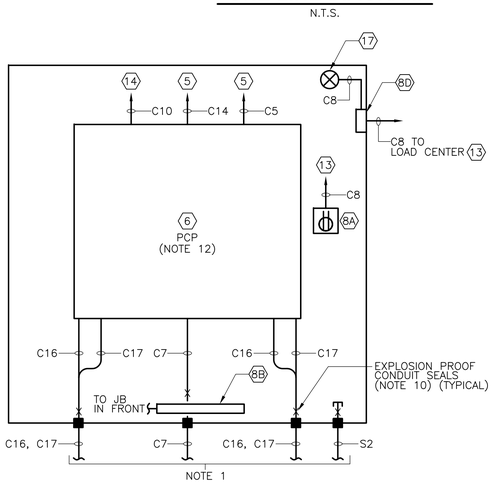
FRONT AND BACK VIEW

ELEVATION

N.T.S.



FRONT VIEW – INTERIOR



BACK VIEW – INTERIOR

OUTDOOR PAD MOUNTED ELECTRICAL CABINET

ELEVATION

N.T.S.

C1 S1 — **SECTION 1** N.T.S. 34

C16 C17 C7 C16 C17 S2 — **SECTION 2** N.T.S. 34

C11 C6 S3 C4 — **SECTION 3** N.T.S. 34

RECORD DRAWING

REV. NO.	DATE	DRWN	CHKD	REMARKS
1	03/09	EJR	SMK	REVISED FOR RECORD

DESIGNED BY: M. FAVALORO
DRAWN BY: M. FAVALORO
SHEET CHK'D BY: B. SQUIBB
CROSS CHK'D BY: R. SOUPPA
APPROVED BY: R. SOUPPA
DATE: JANUARY 2007

CDM Camp Dresser & McKee Inc.
consulting engineering construction operations

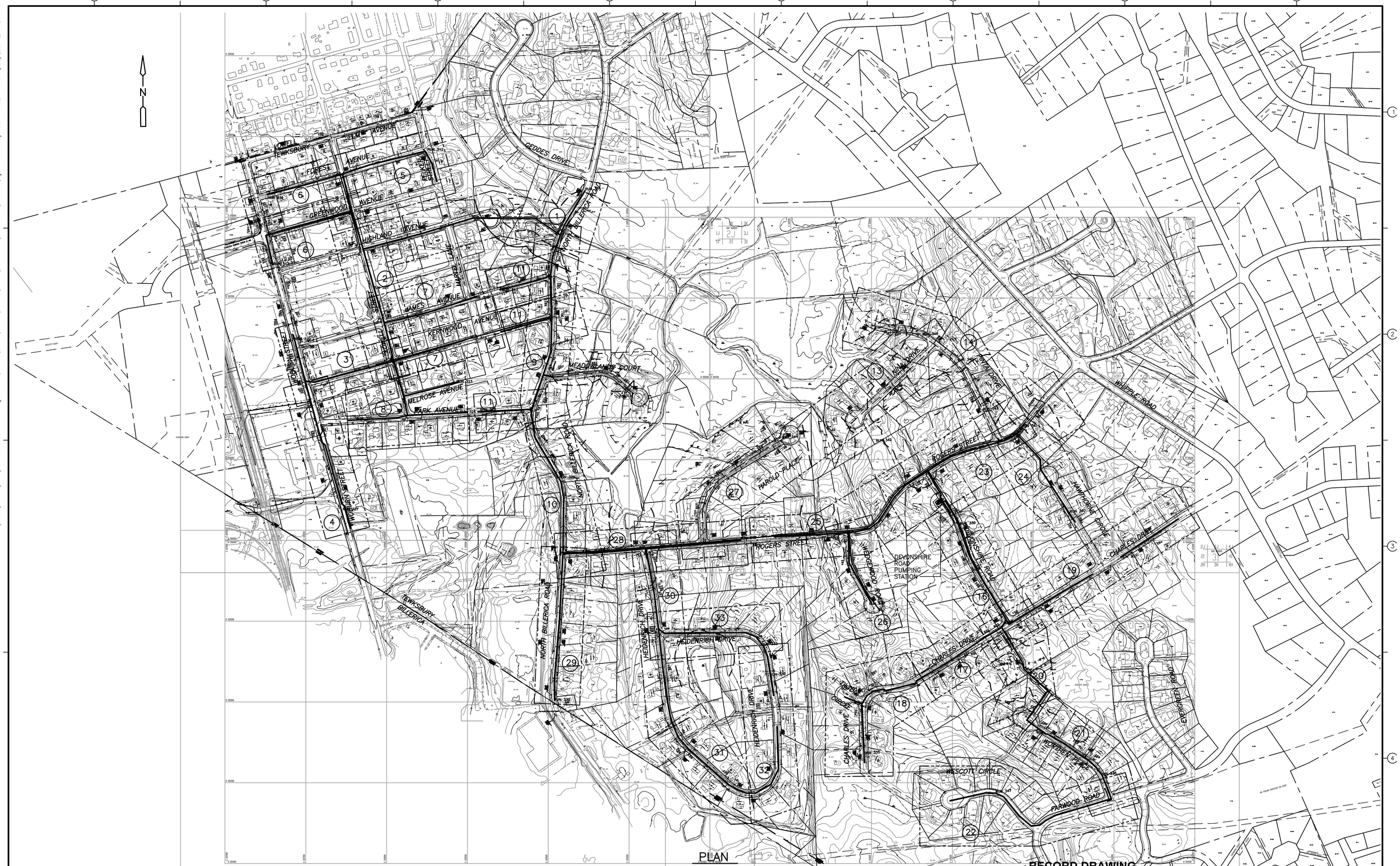
TOWN OF TEWKSBURY, MASSACHUSETTS
SEWERAGE WORKS IMPROVEMENTS
PHASE 9
CONTRACT NO. 31

DEVONSHIRE ROAD PUMPING STATION
ELECTRICAL DETAILS & ONE LINE DIAGRAM

PROJECT NO. 0959–44636
FILE NAME: EOLDI001
SHEET NO. 36
ACCESSION NO. 0959–70374

[TEWKSBURY, MA — CONTRACT 31 PHASE 9 SEWER DESIGN] Plotted by: CONAWAYJE Time: 1/30/2007 2:41:37 PM

Filename: R:\0959\44636\CIVIL\KEYPLAN.DWG Xref's: [C24X36H, TK2HT, TK2IT, TK2JT, TK3HT, TK3IT, CSVPL001, PROPERTY, LAYOUT,]



PLAN
SCALE: 1"=250'-0"

RECORD DRAWING

REV. NO.	DATE	DRWN	CHKD	REMARKS
1	03/09	EJR	SMK	REVISED FOR RECORD

DESIGNED BY: M. COTE
DRAWN BY: B. GUILFORD
SHEET CHK'D BY: M. GUIDICE
CROSS CHK'D BY: R. SOUPPA
APPROVED BY: R. SOUPPA
DATE: JANUARY 2007

CDM Camp Dresser & McKee Inc.
consulting engineering construction operations

TOWN OF TEWKSBURY, MASSACHUSETTS
SEWERAGE WORKS IMPROVEMENTS
PHASE 9
CONTRACT NO. 31

GENERAL PLAN

PROJECT NO. 0959-44636
FILE NAME: GENERAL PLAN

SHEET NO.
GP

ACCESSION NO. 0959-70338

Woodard & Curran

woodardcurran.com